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TRANSACTIONS

OF THE

AMERICAN ORTHOPEDIC ASSOCIATION.

NINTH SESSION,

HELD AT CHICAGO, ILL.,

SEPTEMBER 17, 18, AND 19, 1895.

VOLUME VIII.

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1896.

The Association does not officially endorse the opinions presented in the different papers published in its Transactions.

DORNAN, PRINTER,
PHILADELPHIA.

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LIST OF OFFICERS.

[Elected September 19, 1895.]

PRESIDENT.

ROYAL WHITMAN, M.D.

VICE-PRESIDENTS.

GEORGE W. RYAN, M.D.
JOEL E. GOLDTHWAIT, M.D.

TREASURER.

E. G. BRACKETT, M.D.

SECRETARY.

JOHN RIDLON, M.D.,
103 State Street, Chicago.

COMMITTEE ON MEMBERSHIP.

A. J. STEELE, M.D. (*Ch'n*), R. W. LOVETT, M.D.
R. H. SAYRE, M.D. H. AUG. WILSON, M.D.
F. S. COOLIDGE, M.D.

EXECUTIVE COMMITTEE.

The President, the Treasurer, and the Secretary.

PUBLICATION COMMITTEE.

E. H. BRADFORD, M.D. (*Ch'n*), J. E. GOLDTHWAIT, M.D.
H. L. TAYLOR, M.D.

MEMBER OF EXECUTIVE COMMITTEE, CONGRESS OF AMERICAN PHYSICIANS AND SURGEONS.

A. M. PHELPS, M.D.
Alternate: E. H. BRADFORD, M.D.

LIST OF PRESIDENTS.

1887. V. P. GIBNEY, M.D.
1888. NEWTON M. SHAFFER, M.D.
1889. E. H. BRADFORD, M.D.
1890. DE FOREST WILLARD, M.D.
1891. A. B. JUDSON, M.D.
1892. BENJAMIN LEE, M.D.
1893. A. J. STEELE, M.D.
1894. A. M. PHELPS, M.D.
1895. JOHN RIDLON, M.D.
1896. ROYAL WHITMAN, M.D.

MEMBERS.

* Original Members.
† Deceased.

1889. Bartow, Bernard, M.D. Clinical Professor of Orthopedic Surgery in the Medical Department of the University of Buffalo; Orthopedic Surgeon to Children's Hospital of Buffalo. 481 Delaware Avenue, Buffalo, N. Y.

1892. Blanchard, Wallace, M.D. Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 34 E. Monroe Street, Chicago.

1889. Brackett, E. G., M.D. Assistant Surgeon to the Children's Hospital. 133 Newbury Street, Boston.

*1887. Bradford, E. H., M.D. Visiting Surgeon to the Children's and the Good Samaritan Hospitals; Assistant Professor of Orthopedic Surgery in Harvard Medical School. 133 Newbury Street, Boston.

*†1887. Brown, Buckminster, M.D.

*1887. Brown, Dillon, M.D. Adjunct Professor of Diseases of Children in the New York Polyclinic; Consulting Physician (in Pediatrics) to the Astoria Hospital; Visiting Physician to the Episcopal Orphans' Asylum and the St. John's Guild Hospital for Children. 40 East Fifty-seventh Street, New York.

*1887. Bryant, Joseph D., M.D. Professor of Anatomy and of Clinical Surgery, and Associate Professor of Orthopedic Surgery in Bellevue Hospital Medical College; Visiting Surgeon to Bellevue and St. Vincent Hospitals; Surgeon-General National Guard, S. N. Y. 54 West Thirty-sixth Street, New York.

1889. Burrell, Herbert L., M.D. Surgeon to the Boston City and Children's Hospitals; Assistant Professor of Clinical Surgery, Harvard University. 22 Newbury Street, Boston.

1891. Cook, Ansel G., M.D. Orthopedic Surgeon to the Hartford Hospital. 164 High Street, Hartford, Conn.

1893. Coolidge, Frederic S., M.D. Demonstrator of Orthopedic Appliances in Rush Medical College; Professor of Orthopedic Surgery, Chicago Post-Graduate Medical School; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 103 State Street, Chicago.

1895. Dane, John, M.D. Surgeon to Marcella Street Orphan Home. 11 Arlington Street, Boston, Mass.

*†1887. Develin, Edward, M.D.

*1887. Foster, Charles C., M.D. Orthopedic Surgeon to the Cambridge Hospital; Visiting Physician to the Avon Home for Children; Visiting Physician to St. Luke's Home for Children. 5 Riedesel Avenue, Cambridge, Mass.

*1887. Gibney, V. P., M.D. Clinical Professor of Surgery in the College of Physicians and Surgeons; Surgeon-in-chief to the New York Hospital for Ruptured and Crippled; Orthopedic Surgeon to the Nursery and Child's Hospital, and to the Montefiore Home and Hospital, New York. 16 Park Avenue, New York.

1889. Gillette, Arthur J., M.D. Visiting Orthopedic Surgeon to University Dispensary; and Orthopedic Surgeon to St. Luke's Hospital, St. Paul. 301 Pleasant Avenue, St. Paul, Minnesota.

1892. Goldthwait, Joel E., M.D. Surgeon to the Good Samaritan Hospital; Assistant Surgeon to the Children's Hospital; Orthopedic Surgeon to Carney Hospital; Surgeon to Marcella Street Orphans' Home. 398 Marlborough Street, Boston.

1892. Griffith, J. D., M.D. Professor of Surgery, Kansas City Medical College; Surgeon to All Saints, St. Joseph's, Children's, and German Hospitals; President of the State Board of Health; Surgeon-General National Guard, S. Mo. S. W. corner Ninth and Grand Avenue, Kansas City, Missouri.

1892. Hoadley, A. E., M.D. Professor of Orthopedic Surgery and Surgical Diseases of Joints, Chicago Polyclinic; Professor of Orthopedic Surgery and Surgical Diseases of Joints and Clinical Surgery, College of Physicians and Surgeons; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children, Chicago. 683 Washington Boulevard, Chicago.

*1887. Hogden, Harry, M.D. Professor of Orthopedic Surgery, St. Louis Medical College (Medical Department of Washington University). 2604 Locust Street, St. Louis.

1893. Hosmer, A. B., M.D. Orthopedic Surgeon to St. Luke's Hospital; Attending Orthopedic Surgeon to the Home for Destitute Crippled Children. 103 State Street, Chicago.

1893. Hubbard, LeRoy W., M.D. Senior Assistant Surgeon, New York Orthopedic Hospital and Dispensary. 161 West Twenty-third Street, New York.

*1887. Judson, A. B., M.D. Orthopedic Surgeon to Out-patient Department of the New York Hospital. 25 Madison Avenue, New York.

1894. Kerr, James, M.D., M.Ch. Surgeon to the Emergency Hospital; Surgeon to the Providence Hospital; Surgeon to the Woman's Hospital; Professor of Surgery in the Georgetown University. 1711 H Street, N. W., Washington, D. C.

*1887. Ketch, Samuel, M.D. Senior Assistant Surgeon to the New York Orthopedic Hospital; Surgeon to the Randall's Island Hospital; Clinical Professor of Orthopedic Surgery in the New York Woman's Medical College. 328 West Twenty-ninth Street, New York.

*1887. Lee, Benjamin, M.D. Secretary of the State Board of Health of Pennsylvania; Professor of Orthopedics in the Philadelphia Polyclinic and College for Graduates in Medicine. 1532 Pine Street, Philadelphia.

*1887. Lovett, Robert W., M.D. Surgeon to the West End Nursery; Assistant Surgeon to the Children's Hospital; Out-patient Surgeon to the Boston City Hospital. 234 Marlborough Street, Boston.

1893. McCurdy, Stewart Le Roy, M.D. Professor of Orthopedic and Clinical Surgery, Ohio Medical University, Columbus, Ohio; Lecturer on Topographical Anatomy and Landmarks, Western Pennsylvania Medical College, Pittsburg, Pa.; Surgeon to the Protestant Hospital, Columbus, Ohio. 912 Penn Avenue, Pittsburg, Pa.

1889. McKenzie, B. E., M.D. Lecturer on Orthopedic Surgery in the Woman's Medical College; Consulting Orthopedic Surgeon to the Hospital for Sick Children, Toronto. 14 Bloor Street, West, Toronto, Canada.

*1887. Moore, James E., M.D. Professor of Orthopedic Surgery in the University of Minnesota; Orthopedic Surgeon to St. Mary's Hospital; Consulting Surgeon to the Northwestern Hospital for Women and Children. 125 Fourth Street, South, Minneapolis, Minn.

1889. Myers, T. Halsted, M.D. Orthopedic Surgeon to St. Luke's Hospital; Assistant Surgeon to the New York Orthopedic Dispensary; Surgeon to the Presbyterian Hospital Dispensary. 24 West Fiftieth Street, New York.

*1887. Packard, George B., M.D. Professor of Orthopedic Surgery in the University of Colorado. 1405 Stout Street, Denver.

*1887. Park, Roswell, M.D. Professor of Surgery in the Medical Department of the University of Buffalo; Surgeon to the Buffalo General Hospital; Consulting Surgeon to the Fitch Accident Hospital and the Buffalo Eye and Ear Infirmary. 510 Delaware Avenue, Buffalo, N. Y.

1890. Phelps, A. M., M.D. Professor of Surgery in the University of Vermont; Professor of Orthopedic Surgery in the University of the City of New York, Medical Department; Professor of Orthopedic Surgery in the Post-Graduate Medical School and Hospital; Visiting Surgeon to the City Hospital, New York; Consulting Surgeon to the Mary Fletcher Hospital, Burlington, Vt.; Surgeon-in-chief to the Orthopedic Department of the Post-Graduate Hospital, New York. 40 West Thirty-fourth Street, New York.

1893. Plimpton, W. O., M.D. Instructor in Orthopedic Surgery, Post-Graduate Medical School and Hospital; Assistant to the Chair of Orthopedic Surgery, University Medical School; Visiting Surgeon to the Post-Graduate Hospital, New York. 40 West Thirty-fourth Street, New York.

*1887. Ridlon, John, M.D. Professor of Orthopedic Surgery in the Northwestern University Medical School; Senior Attending Orthopedic Surgeon to St. Luke's Hospital, and Michael Reese Hospital; Medical Director of the Home for Destitute Crippled Children. 103 State Street, Chicago.

*1887. Ryan, George W., M.D. Clinical Lecturer on Orthopedic Surgery in the Medical College of Ohio. 114 West Ninth Street, Cincinnati.

*†1887. Sayre, Lewis Hall, M.D.

*1887. Sayre, Reginald H., M.D. Lecturer Adjunct on Orthopedic Surgery in the Bellevue Hospital Medical College; Orthopedic Surgeon to the Out-door Department of Bellevue Hospital; Consulting Surgeon to the Hackensack, N. J., Hospital. 285 Fifth Avenue, New York.

*1887. SCHAPPS, JOHN C., M.D. Orthopedic Surgeon to St. Mary's Hospital Dispensary, Brooklyn. 498 Bedford Avenue, Brooklyn.

1889. SCUDDER, CHARLES LOCKE, M.D. Assistant in Surgery in Harvard University; Surgeon to the Out-patient Department of Massachusetts General Hospital. 1 Marlborough Street, Boston.

*1887. SHAFFER, NEWTON M., M.D. Attending Surgeon-in-charge of the New York Orthopedic Hospital and Dispensary; Consulting Orthopedic Surgeon to St. Luke's Hospital; Consulting Surgeon to the New York Infirmary for Women and Children. 28 East Thirty-eighth Street, New York.

1889. SHERMAN, HARRY M., M.D. Orthopedic Surgeon to the Children's Hospital and to the Polyclinic, San Francisco. 1303 Van Ness Avenue, San Francisco.

*1887. STEELE, A. J., M.D. Professor of Orthopedic Surgery and Diseases of the Joints in the St. Louis Post-Graduate School of Medicine; Surgeon to the Augusta Children's Hospital, St. Louis. 2825 Washington Avenue, St. Louis.

*1887. TAYLOR, HENRY LING, M.D. 117 West Fifty-fifth Street, New York.

1892. TAYLOR, WILLIAM J., M.D. Surgeon to St. Agnes's Hospital; Assistant Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases. 116 South Eighteenth Street, Philadelphia.

1892. THORNDIKE, AUGUSTUS, M.D. Surgeon to the Good Samaritan Hospital and to the Boston Dispensary. 101 Beacon Street, Boston.

1889. TOWNSEND, W. R., M.D. Professor of Orthopedic Surgery in the New York Polyclinic; Assistant Surgeon to the Hospital for Ruptured and Crippled, New York; Visiting Surgeon to Randall's Island and Bayonne Hospital; Consulting Orthopedic Surgeon to the French Hospital. 28 West Fifty-ninth Street, New York.

1889. WEIGEL, LOUIS A., M.D. Orthopedic Surgeon to the Out-patient Department of Rochester City Hospital. 43 Mortimer Street, Rochester, N. Y.

1890. WHITMAN, ROYAL, M.D. Clinical Instructor in Orthopedic Surgery and Chief of the Orthopedic Division of the Vanderbilt Clinic in the College of Physicians and Surgeons; Adjunct Professor of Orthopedic Surgery in the New York Polyclinic; Assistant Sur-

geon to the Hospital for Ruptured and Crippled, New York. 126 West Fifty-ninth Street, New York.

*1887. Willard, De Forest, M.D. Clinical Professor of Orthopedic Surgery in the University of Pennsylvania; Surgeon to the Presbyterian Hospital; Consulting Surgeon to the White Cripples' Home, the Colored Cripples' Home, and the Home for Incurables, Philadelphia; Consulting Surgeon to the New Jersey State School for Feeble-minded Children. 1601 Walnut Street, Philadelphia.

1891. Wilson, H. Augustus, M.D. Clinical Professor of Orthopedic Surgery in the Jefferson Medical College; Professor of General and Orthopedic Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Orthopedic Surgeon in the Polyclinic Hospital; Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Surgeon to St. Mark's Home for Aged and Infirm Women, Philadelphia; Consulting Orthopedic Surgeon to the Kensington Hospital for Women, and to the Philadelphia Lying-in Charity. 1611 Spruce Street, Philadelphia.

1893. Wirt, William E., M.D. Professor of Orthopedic Surgery in the Medical Department University of Wooster, Cleveland, Ohio; Visiting Surgeon to University Hospital; Orthopedic Surgeon to Cleveland Hospital for Women and Children. 122 Euclid Avenue, Cleveland, Ohio.

1890. Young, James K., M.D. Instructor in Orthopedic Surgery in the University of Pennsylvania; Attending Surgeon to the Orthopedic Department of the University Hospital. 222 South Sixteenth Street, Philadelphia.

HONORARY MEMBERS.

ELECTED

1895. WILLIAM ADAMS, F.R.C.S., Senior Surgeon to the Great Northern Central Hospital and to the National Hospital for the Paralytic and Epileptic; Consulting Surgeon to the National Orthopedic Hospital. 5 Henrietta Street, Cavendish Square, W., London, England.

1891. EDMUND ANDREWS, M.D., 65 Randolph Street, Chicago, Illinois.

1889. HENRY G. DAVIS, M.D., 8 Parlin Street, Everett, Mass.

*1892. WILLIAM DETMOLD, M.D., New York.

1893. O. LANNELONGUE. Professeur à la Faculté de Médecine de Paris (Chaire de Chirurgie); Membre de l'Académie de Médecine; Chirurgien de l'Hôpital Trousseau â Paris, et Député au Parlement Français, et Président de l'Association Générale de Médecine de France. 3 Rue François I., Paris.

*1889. W. J. LITTLE, M.D., F.R.C.P. Lond., M.R.C.S. Eng.

1890. WILLIAM MACEWEN, M.D., LL.D., Professor of Clinical Surgery, and Surgeon to the Glasgow Royal Infirmary; Surgeon to the Royal Hospital for Sick Children. 3 Woodside Crescent, Glasgow, Scotland.

1893. LEOPOLD OLLIER, M.D., Professeur du Clinique Chirurgicale à la Faculté de Médecine de Lyon; Correspondant de l'Institut de France. 3 Quai de la Charité, Lyons.

*1889. DAVID PRINCE, M.D.

1889. LEWIS A. SAYRE, M.D. Professor of Orthopedic Surgery in the Bellevue Hospital Medical College; Consulting Surgeon to the Bellevue Hospital, the Charity Hospital, and the Home for Incurables. 285 Fifth Avenue, New York.

1891. C. FAYETTE TAYLOR, M.D., 201 West Fifty-fourth Street, New York.

* Deceased.

CORRESPONDING MEMBERS.

ELECTED

1889. Dr. F. BEELY, Steglitzer Strasse 10, Berlin, Germany.

1892. Dr. M. BILHAUT, Rédactuer en Chef des Annales d'Orthopédie et de Chirurgie pratiques; Chirurgien des enfants de l'Hôpital International. 5 Avenue de l'Opera, Paris, France.

1894. BERNARD E. BRODHURST, F.R.C.S. Eng. Senor Surgeon to the Royal Orthopedic Hospital; Surgeon to the Royal Hospital for Incurables; Consulting Surgeon to the Belgrave Children's Hospital. 20 Grosvenor Street, Grosvenor Square, London, W.

1894. Dr. JULIUS DOLLINGER, ausserordentlich-öffentlicher Professor für Orthopädie an den königl. ungarischen Universität in Buda-Pest, Operateur und dirigirenden Oberarzt der chir. Abtheilung im Spitalls der Barmherzigen Brüder in Buda-Pest; Mitglied des Landessanitätsrathes; Mitglied des Landesunterrichtsrathes; Mitglied mehrer wissenschaftlichen Gesellschaften und Vereine. Buda-Pest (Ungarn), Rerepescher Str. 52.

1892. NICHOLAS GRATTAN, F.R.C.S. Edin., Senior Surgeon County and City of Cork Hospital for Women and Children. 24 South Mall, Cork, Ireland.

1890. Dr. A. HOFFA, Privatdocent der Chirurgie an der Universität Würzburg. Sieboldstrasse 10, Würzburg.

1890. ROBERT JONES, F.R.C.S. Edin., Honorary Surgeon, Royal Southern Hospital. 11 Nelson Street, Great George Square, Liverpool, England.

1890. Dr. E. KIRMISSON, Professeur agrégé de la Faculté de Médecine; Chirurgien de l'Hôpital des Enfants Assisté. 27 Quai d'Orsay, Paris, France.

ELECTED

1890. Dr. SIGFRED LEVY, Superintending Surgeon of the Society for the Relief of Crippled and Mutilated Children, Copenhagen. 135 Gothersgade, Copenhagen, Denmark.

1892. ERNEST MUIRHEAD LITTLE, F.R.C.S. Eng. Surgeon to the National Orthopedic Hospital. 40 Seymour Street, Portman Square, London, England.

1889. Prof. Dr. ADOLF LORENZ. IX. Garnisongasse 3 (Garellihoff), Vienna, Austria.

1889. HOWARD MARSH, F.R.C.S. Eng., Senior Assistant Surgeon and Lecturer on Surgery, St. Bartholomew's Hospital; Consulting Surgeon, Hospital for Sick Children, and Alexandra Hospital for Hip Disease. 30 Bruton Street, W., London, England.

1890. EDMUND OWEN, M.B., F.R.C.S., Surgeon to and Joint Lecturer on Surgery at St. Mary's Hospital; Senior Surgeon to the Hospital for Sick Children, Great Ormond Street. 64 Great Cumberland Place, W., London, England.

1892. PIETRO PANZERI, M.D., Direttore di Istituto dei Rachitici, Milano. Via S. Calimero 31, Milano, Italy.

1892. ROBERT WILLIAM PARKER, M.R.C.S. Eng., Senior Surgeon, East London Hospital for Children; Surgeon German Hospital, Dalston. 13 Welbeck Street, W., London, England.

1890. PAUL REDARD, M.D., Lauréat de l'Institut; Ancien Chef de Clinique Chirurgicale de la Faculté de Médecine de Paris; Chirurgien du Dispensaire Furtado-Heine. 3 Rue de Turin, Paris, France.

1888. BERNARD ROTH, F.R.C.S. Eng. 29 Queen Anne Street, Cavendish Square, W., London, England.

1890. NOBLE SMITH, F.R.C.S. Edin., L.R.C.P. Lond., M.R.C.S. Eng., D.M.; Surgeon to All Saints' Children's Hospital; Orthopedic Surgeon to British Home for Incurables. 24 Queen Anne Street, Cavendish Square, W., London, England.

*1890. HUGH OWEN THOMAS, M.R.C.S. Eng.

* Deceased.

ELECTED

1890. W. J. WALSHAM, F.R.C.S. Eng., M.B. and C.M. Aberdeen; Assistant Surgeon and Surgeon in Charge of Orthopedic Department, and Lecturer on Anatomy, St. Bartholomew's Hospital; Surgeon, Metropolitan Hospital; Consulting Surgeon to Hospital for Hip Diseases, Sevenoaks, and to the Burnley Cottage Hospital. 77 Harley Street, London, England.

1890. GEORGE ARTHUR WRIGHT, B.A., M.B. Oxon. F.R.C.S.; Senior Assistant Surgeon, Royal Infirmary, Manchester, Surgeon to Children's Hospital, Pendlebury and Manchester. 8a St. John Street, Manchester, England.

MINUTES

OF THE

NINTH ANNUAL MEETING

OF THE

AMERICAN ORTHOPEDIC ASSOCIATION.

Held at Chicago on September 17, 18, and 19, 1895.

First Day—*Morning Session.*

The Association met at the Columbus Memorial Building, 103 State Street, and was called to order by the President, Dr. John Ridlon, at 9.30 o'clock.

The President read an address entitled "The Growth and Prosperity of the American Orthopedic Association."

A paper on "Congenital Absence of Radii, with Operation," was read by Dr. S. L. McCurdy, who also reported a case of "Congenital Deformity of the Hand."

Discussed by Drs. Ridlon, Gibney, Goldthwait, and McCurdy.

Dr. J. E. Goldthwait reported a case of "Dislocation of Both Patellas of Twenty Years' Duration Treated by Means of Operation."

Discussed by Drs. Whitman, Moore, and Goldthwait.

Dr. A. M. Phelps read a paper entitled "The Report of a Case of Congenital Dislocation of the Shoulder and an Operation for its Relief."

Discussed by Drs. Gibney and Phelps.

Dr. J. E. Moore read a paper on "Removal of Astragalus for Talipes Valgus."

Discussed by Drs. Whitman, Hoadley, and Moore.

Dr. Moore reported a case of "Deformity of the Pelvis Accompanying Hip Disease," which had made necessary Cæsarean section.

The President filled vacancies on the Committee on Membership by appointing Drs. Weigel, Sayre, and Lovett.

Dr. J. E. Goldthwait read a paper entitled "Tendon Transplantation in the Treatment of Paralytic Deformities of the Feet; a Report of Cases."

Discussed by Drs. Goldthwait, Whitman, and Lovett.

Dr. S. L. McCurdy presented a "Hip-splint;" as did also Dr. John Ridlon.

Discussed by Drs. Sayre, Hoadley, Phelps, and McCurdy.

At 12 o'clock the Association went into

Executive Session.

The Committee on Membership reported formally on the name of Dr. John Dane, of Boston. Dr. Dane was unanimously elected.

It was voted that the action of the Committee on Nomination be reported to the Association.

The amendment to the Constitution proposed at the meeting of 1894, by Dr. E. H. Bradford and seconded by Dr. F. S. Coolidge, the words "Corresponding Members shall pay annual dues of five dollars," comprising the last sentence of Article VIII. of the Constitution, "Shall be expunged," was, on motion of Dr. McCurdy, passed unanimously.

The amendment to the Constitution of Section 2, Article IV., proposed by Dr. N. M. Shaffer and seconded by Dr. W. R. Townsend, at the meeting of 1894, "It shall at the first annual meeting held after the adjournment of any Congress elect a member to represent it on the Executive Committee of the Congress for the ensuing three years; and it shall also elect a second member as alternate," was, on motion of Dr. Lovett, passed unanimously.

Dr. Steele moved that a committee be appointed to consider certain suggestions made by the President in his address, more particularly the question of the establishment of a journal to be devoted to orthopedic surgery by the Association. After debate a committee consisting of Drs. Lovett, Ridlon, and Whitman was appointed, with instructions to consider the question and to report at the next annual meeting of the Association.

Acting on a suggestion of the President, and on the motion of Dr. Steele, it was voted that the name of Mr. William Adams, of London, be transferred from the list of Corresponding Members to that of Honorary Members. The Secretary was instructed to cast the ballot of the Association to that effect.

The Treasurer's report was presented, and was referred to an Auditing Committee, consisting of Drs. Steele and Ryan, appointed by the President.

On motion of Dr. Lovett, it was voted that the Auditing Committee be instructed to recommend action to the Association in instances in which the dues had remained unpaid, and also in those instances in which neither initiation fees nor annual dues had been received.

The session then adjourned.

Afternoon Session.

The session was called to order by the President at 2.25 o'clock.

Dr. Royal Whitman read a paper entitled "A Study of the Weak Foot, with Reference to its Causes, its Diagnosis, and its Cure; with an Analysis of One Thousand Cases of so-called Flat-foot."

Dr. R. W. Lovett and Dr. John Dane presented, through Dr. Lovett, a paper entitled "Flat-foot."

Dr. L. A. Weigel read a paper on "Metatarsalgia."

The papers were discussed by Drs. Sayre, Gibney, Park, Goldthwait, Ryan, Gillette, Phelps, Lovett, Weigel, and Whitman.

Dr. Roswell Park read a paper entitled "The Deformities Produced by Acute Inflammatory Lesions in Bone."

Discussed by Drs. Moore, Whitman, and Park.

The session adjourned at 5 o'clock.

The following communications were received by the Secretary during the day and presented to the Association:

A congratulatory telegram from Dr. J. D. Griffith. A letter thanking the members for the prompt answers received to letter of inquiry by Dr. Samuel Ketch. An invitation to the members to the clinic by Dr. J. B. Murphy. Messrs. Chas. Truax, Greene & Co. invited the members to visit their establishment.

The privileges of the University Club were extended to the Association through Dr. Ridlon, and those of the Chicago Club through Dr. Coolidge. Also those of the Chicago Athletic Club through Dr. Hosmer.

SECOND DAY—*Morning Session.*

The meeting was called to order by the President at 9 o'clock.

Dr. James Kerr read a paper on "Joint Disability Following Fractures."

Discussed by Drs. Sayre, Moore, Whitman, and Gillette. Dr. Kerr closed the discussion.

Dr. R. W. Lovett read a paper entitled "Ambulatory Treatment of Pott's Disease."

Dr. E. G. Brackett read a paper on "The Use of the Plaster Jacket in Caries and the Effect of Position on the Spine."

The papers were discussed by Drs. Steele, Gillette, Gibney, Shaffer, Sayre, Whitman, McCurdy, Ridlon, and Lovett.

Dr. A. E. Hoadley read a paper on "The New Anterior Spine Brace."

Dr. R. H. Sayre read a paper entitled "The Result of Several Cases of Spondylitis of the Second Cervical Vertebra."

Dr. J. E. Goldthwait presented two specimens, one of tuberculous disease of the lumbar region of the spine and another similar specimen showing carcinomatous changes at the point of disease.

The President presented, for Dr. F. C. Schapps, a night-shirt to be used in the treatment of Pott's disease.

The session adjourned at 12.15 o'clock.

Third Day—*Morning Session.*

The meeting was called to order by the President at 9 o'clock.

Dr. Edmund Andrews read a paper entitled "A Study of the Interior Forms and Burrowings of Lumbar Abscesses."

Dr. A. M. Phelps read a paper entitled "How the Orthopedic Surgeon should Treat Abscesses, Tubercular and Purulent."

Dr. V. P. Gibney presented a "Traction Brace for the Treatment of Knee-joint Disease."

Discussed by Drs. Ridlon and Goldthwait.

On motion of Dr. Ridlon, Dr. Skeer, of Chicago, was invited to present a saw to be used in excision of the knee-joint and in similar operations.

Dr. W. O. Plimpton read a paper on "Excision of the Knee as an Orthopedic Procedure."

Discussed by Drs. Moore, Sayre, Phelps, McCurdy, and Plimpton.

Dr. A. J. Steele presented appliances, with remarks, entitled "Kinks n Club-foot Rectification, in Head Traction, and in Hip Traction."

Discussed by Drs. Whitman, Plimpton, and Steele.

Dr. R. H. Sayre showed casts and read a paper on "Double Congenital Equino-varus, Astragalectomy, and Supra-malleolar Osteotomy."

Discussed by Drs. Gibney, Weigel, Gillette, Phelps, Huntley, and Sayre.

Dr. L. A. Weigel read a paper on "The Use of Mechanical Sup-

ports in the Treatment of Scoliosis," and presented an improved paper corset.

Discussed by Drs. Gibney, Sayre, and Weigel.

Dr. A. B. Judson presented to the individual members models illustrating the effect of deformities of the hip and spine.

Dr. E. G. Brackett presented, on behalf of Dr. G. W. Fitz, a paper on "Infantile Paralysis."

On motion of Dr. A. M. Phelps, it was voted that the papers not read before the Association be read by title.

At 12 o'clock the Association went into

Executive Session.

The Auditing Committee reported that the Treasurer's report was correct and that all arrears in dues had been paid.

It was recommended that a candidate's name be dropped if within three months after his election the dues shall not have been paid.

The Chairman of the Committee gave notice that this and possibly other recommendations were to be submitted to the Association as proposed amendments.

Dr. Shaffer moved that the report be accepted and the committee discharged. It was so voted.

A letter from Dr. Ap Morgan Vance, tendering his resignation, was received. It was voted that the resignation be accepted.

It was voted that a communication received from Dr. T. Selva, of Boston, entitled "A Modification of Bradford's Frame for Extending the Spine in Dorsal Decubitus," be referred to the Committee on Publication.

It was voted that the thanks of the Association be tendered to Mr. H. J. Furber for his courtesy in providing the place of meeting for the Association. Also to the Chicago, the University, and the Athletic Clubs for privileges extended to the members; and the Chicago Orthopedic Society.

At the suggestion of the President, it was voted that the name of Dr. Lewis A. Sayre be transferred from the list of members to that of honorary members.

The question of election of Delegates to the Congress of American Physicians and Surgeons was raised by Dr. Shaffer.

After discussion, it was, on motion of Dr. Sayre, unanimously voted that the action of the Association at the meeting of 1894 be confirmed, and that Dr. A. M. Phelps, as member of the Executive Committee,

and Dr. E. H. Bradford, as alternate, to the Congress of American Physicians and Surgeons, be declared elected.

Dr. A. M. Phelps returned thanks for the honor of representing the Association.

The Association then elected officers for 1895–96:

President—Dr. Royal Whitman, of New York.

First Vice-President—Dr. George W. Ryan, of Cincinnati.

Second Vice-President—Dr. Joel E. Goldthwait, of Boston.

Treasurer—Dr. E. G. Brackett, of Boston.

Secretary—Dr. John Ridlon, of Chicago.

As before stated, Dr. A. M. Phelps as Delegate and Dr. E. H. Bradford as Alternate to the Congress of American Physicians and Surgeons.

On motion of Dr. Sayre, it was voted that the invitation of Dr. Parks that the Association hold its next meeting in Buffalo, N. Y., be accepted.

On motion of Dr. Steele, it was voted that the next annual meeting be held during the third week in May, 1896.

Candidates for membership were proposed: Dr. H. P. Woley, of Chicago, by Drs. Ridlon and Hosmer; Dr. William N. Bullard, of Boston, by Drs. Brackett and Goldthwait.

The following papers were read by title:

"The Treatment of Fractures from an Orthopedic Standpoint," by Dr. A. M. Phelps.

"Observations on the So-called Congenital Dislocation at the Hip-joint, and the Success of Dr. Buckminster Brown's Treatment by Recumbency with Extension for Two Years," by Mr. Wm. Adams, of London.

"On the Surgical Treatment of Congenital Dislocation of the Head of the Thigh Bone," by Mr. Bernard Brodhurst, of London.

"Operative Treatment for Congenital Dislocation of the Hip," by Dr. Wm. E. Wirt.

"A Case of Double Congenital Knee Luxation," by Dr. H. L. Taylor.

"Treatment of Slipping Patella," by Dr. E. H. Bradford.

"A Case of Talipes Varus, Following Section of the Biceps Cruris Tendon; Neurorrhaphy After Six Years, Without Benefit," by Mr. E. Muirhead Little, of London.

"A Report of Seventy Cases of Splicing of the Tendo-Achilles," by Dr. H. Augustus Wilson.

"Treatment of Rigid Flat-foot by Localized Hot-air Bath," by Mr. W. J. Walsham, of London.

"One Thousand Cases of Lateral Curvature of the Spine treated by Posture and Exercise Exclusively (without Mechanical Supports)," by Mr. Bernard Roth, of London.

"The Treatment of Lateral Curvature of the Spine Without Corsets," by Mr. Noble Smith, of London.

"The Treatment of Scoliosis by Light Gymnastic Exercises," by Dr. James K. Young.

"On Forcible Correction and Corrective Jackets in the Treatment of Scoliosis," by Dr. Bernard Bartow.

"Spasmodic Wry-neck," by Mr. Noble Smith, of London.

"Spasmodic Wry-neck, with Especial Reference to Conium and Atropin, by Dr. T. Halstead Myers.

"Bone Drilling in Arthritis and Osteitis," by Mr. Noble Smith, of London.

"Some Considerations of the Mechanical Arrangements Around the Hip-joint," by Dr. Harry M. Sherman.

"A Review of the Treatment of Hip Disease," by Dr. B. E. McKenzie.

"Some Remarks Concerning Hip Disease, with Especial Reference to the Deformity," by A. B. Judson.

"Operative Measures in Caries of the Spine," by Dr. E. H. Bradford.

"Spondylitis(?) followed by Hysterical Spine and Chorea," by Dr. A. B. Hosmer.

"The Rawhide Corset Spinal Brace," by Dr. B. E. McKenzie.

"The Anterior Spine Brace," by Dr. J. C. Schapps.

"The Causative Relation of Suppuration to Tubercular Meningitis in Joint and Spine Diseases," by Dr. Samuel Ketch.

"Pain in the Back," by Dr. L. A. Weigel.

"Pigeon-toe," by Dr. James E. Moore.

"Improved Osteoclast," by Nicholas Grattan, of Cork, Ireland.

"Some Cases of Osteoclasis with the Lorenz Osteoclast," by Dr. F. S. Coolidge.

"Idiopathic Osteopsathyrosis," by Dr. Wallace Blanchard.

"Statistical Report of the Orthopedic Department of the South Side Free Dispensary," by Drs. John Ridlon and H. P. Woley.

"A Peculiar Case of Fracture of the Patella."

"A New Method of Performing Circumcision," by Dr. F. A. Goodwin.

The minutes were read and approved and the Association adjourned at 12.15 o'clock.

The following members were present:

Wallace Blanchard, E. G. Brackett, F. S. Coolidge, V. P. Gibney, Arthur J. Gillette, J. E. Goldthwait, A. E. Hoadley, A. B. Hosmer, James Kerr, R. W. Lovett, S. L. McCurdy, James E. Moore, Roswell Park, A. M. Phelps, W. O. Plimpton, John Ridlon, Royal Whitman, G. W. Ryan, R. H. Sayre, N. M. Shaffer, A. J. Steele, and L. A. Weigel.

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

ARTICLE I.—NAME.

THIS Society shall be called the "AMERICAN ORTHOPEDIC ASSOCIATION."

ARTICLE II.—OBJECTS.

The purpose of this Association shall be the advancement of Orthopedic science and art.

ARTICLE III.—MEMBERSHIP.

SECTION 1. The members shall be graduates of regular medical schools, shall be in good professional standing, and shall be especially interested in Orthopedic Surgery.

SEC. 2. There shall be three classes of members, viz.: Active, Corresponding, and Honorary.

SEC. 3. The number of Active Members shall be limited to sixty.

SEC. 4. Candidates for membership shall have been engaged in the practice of medicine for at least five years, and shall have given evidence of satisfactory scientific attainments.

ARTICLE IV.—OFFICERS.

The officers shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary, and a Treasurer, all to be elected annually at the last executive session of a regular meeting.

ARTICLE V.—STANDING COMMITTEES.

There shall be a Committee on Membership, consisting of five members, a Committee on Publication, consisting of three members, and an Executive Committee, consisting of the President, the Secretary, and the Treasurer.

ARTICLE VI.—ELECTIONS.

All elections shall be by ballot; for officers a majority shall elect, for members a four-fifths majority.

ARTICLE VII.—MEETINGS.

The meetings of the Association shall be Regular and Special.

ARTICLE VIII.—FEES.

Active members shall pay an initiation fee of twenty-five dollars, and annual dues of fifteen dollars.

ARTICLE IX.—PUBLISHED PROCEEDINGS.

The business proceedings of the Association shall be published annually. The papers and discussions shall be published annually, unless the Association otherwise directs at the close of the regular meeting.

ARTICLE X.—DISCIPLINE.

A three-fourths vote of all members present at a regular meeting shall be necessary for suspension or expulsion of a member.

ARTICLE XI.—THE CONGRESS.

SECTION 1. This Association shall hold membership in and meet with the Congress of American Physicians and Surgeons.

SEC. 2. It shall, at the first annual meeting held after the adjournment of any Congress, elect a member to represent it on the Executive Committee of the Congress for the ensuing three years, and it shall also elect a second member as an alternate.

ARTICLE XII.—QUORUM.

An actual presence of nine active members at any one meeting shall be necessary for the transaction of business.

ARTICLE XIII.—AMENDMENTS.

Alterations to this Constitution may be made at any regular meeting by a four-fifths vote of all the members present; provided that

notice of the proposed changes, signed by two active members, shall have been given to all the active members at least one month previous to final action.

BY-LAWS.

ARTICLE I.—MEMBERSHIP.

SECTION 1. Nominations for membership shall be made in writing, signed by the proposer and seconder, accompanied by evidence as to the fitness of the candidate for fellowship, and shall be placed in the hands of the Secretary at least twelve months previous to the time of the regular meeting.

SEC. 2. Candidates for active membership shall, through the Secretary, present a paper to the Association.

SEC. 3. Only those of acknowledged pre-eminence in Orthopedic Surgery shall be eligible to honorary membership.

SEC. 4. Foreign residents only shall be eligible to corresponding membership.

SEC. 5. All the scientific privileges of the Association shall be accorded to the honorary and corresponding members.

SEC. 6. Membership shall be forfeited when one ceases to take an active interest in the objects of the Association, or is guilty of an unprofessional act or a public misdemeanor. Action in such cases shall be taken according to Article X. of the Constitution.

SEC. 7. An active member absenting himself for three consecutive meetings, or two years in arrears in payment of dues, may be dropped from the rolls.

SEC. 8. All members in attendance at any meeting shall register in a book provided for the purpose.

ARTICLE II.—OFFICERS AND STANDING COMMITTEES.

SECTION 1. The duties of officers and standing committees shall commence after the adjournment of the meeting at which they are elected or appointed, and shall continue until their successors are duly installed.

SEC. 2. The President shall preside at all meetings, shall deliver an annual address, shall appoint the Committees on Membership and

Publication, shall fill any vacancies that may occur from resignation or otherwise.

Sec. 3. The Vice-Presidents shall act in the absence of the President.

Sec. 4. The Secretary shall give due notice of and keep the minutes of all meetings, shall conduct all correspondence, shall notify candidates of their election to membership, and inform members of their appointment on committees, and shall perform such other duties as are assigned to him by the Association.

Sec. 5. The Treasurer shall collect all money due the Association, be the custodian of the same, and pay it out only on warrant signed by the President and Secretary. At the annual meeting he shall make a report of his receipts and expenditures, which, after being duly audited, shall be filed.

Sec. 6. The Membership Committee shall consider the eligibility of all nominees for membership, and shall report its recommendations to the Association.

Sec. 7. The Executive Committee shall make all necessary arrangements for the meetings of the Association, assign the order for scientific work, and report the same to all members as early as practicable before the time of the annual meeting; it shall further manage such necessary affairs of the Association as are not already assigned to others.

Sec. 8. The Publication Committee shall attend to the preparation, publication, and distribution of the annual proceedings of the Association; and it shall have discretionary power as to matter for publication in questionable cases.

ARTICLE III.—ELECTIONS.

Elections of members shall be held at the first executive session of a regular meeting, and of officers at the last business session.

ARTICLE IV.—MEETINGS.

Section 1. The regular meetings shall be held annually during the third week in September of each year, or at such other time and at such place as the Association may elect. If no action should be taken in the matter, the Executive Committee shall decide.

Sec. 2. Special meetings may be called by the Executive Committee or by the President at the written request of ten active members.

Sec. 3. Every third year the Association shall convene as a part of the Congress of American Physicians and Surgeons.

ARTICLE V.—DUES.

The yearly dues shall be paid to the Treasurer at the time of registration.

ARTICLE VI.—PUBLISHED PROCEEDINGS.

SECTION 1. The Transactions shall be printed as soon after the adjournment of the regular meeting as possible, and distributed to the members, one copy to each except to those in arrears on Association dues.

SEC. 2. Additional copies of the Transactions shall be furnished to members at cost, and to the public at a price to be determined by the Publication Committee.

SEC. 3. Authors desiring reprints of their papers will notify the Publication Committee, who shall already have established rates for reprints with the publishers.

SEC. 4. Papers not in the hands of the Secretary within four weeks after adjournment of the meeting shall be omitted from the Transactions on the unanimous vote of the Publication Committee.

ARTICLE VII.—PAPERS AND DISCUSSIONS.

SECTION 1. Papers read before the Association shall be limited to twenty minutes, unless the time be extended by vote. Discussions shall be limited to five-minute speeches. No member shall speak a second time on the same subject if others desire the floor. The author of the paper shall be privileged to close the debate.

SEC. 2. No papers shall be read that have been previously published. Members publishing their papers after they have been presented to the Association shall designate them, "Read before the American Orthopedic Association." Authors desiring their papers illustrated shall furnish the necessary woodcuts.

SEC. 3. Proofs sent to authors should be returned within a fortnight, otherwise the matter will go to press without the author's correction. Marked changes from copy, known as "time work," shall be paid for by the author.

SEC. 4. Transcripts of the discussion shall be furnished the participants for correction, but not for re-writing.

ARTICLE VIII.—EXECUTIVE.

SECTION 1. Two executive sessions shall be held during each regular annual meeting, to wit: at noon of the first day, and at noon of the last day. The order of business shall be:

1. Reading of unapproved minutes and records.
2. Reports of officers and committees and action thereon.
3. Unfinished business.
4. Election.
5. New business.

The last act before adjournment of the last session shall be the reading of unapproved minutes and action thereon. Urgent business may be transacted at any session by unanimous consent.

SEC. 2. The proceedings of the Association shall be in accordance with parliamentary usage.

ARTICLE IX.—AMENDMENTS.

Proposed Amendments to the By-laws shall be submitted in writing and signed by two active members. Previous notice of the proposed changes shall be given. A three-fourths affirmative vote of all members present at a regular meeting shall be necessary to ratification.

THE PRESIDENT'S ADDRESS.

THE GROWTH AND PROSPERITY OF THE AMERICAN ORTHOPEDIC ASSOCIATION.

By JOHN RIDLON, M.D.,
CHICAGO.

Gentlemen: This is the Tenth Meeting (the Ninth Annual Meeting) of the American Orthopedic Association. As one of the original members, as an Ex-Secretary of three years' service, and as President of the Association at this meeting, I may be pardoned a certain pride that I feel in our past growth and present prosperity, and I may have some excuse for speaking to you upon that subject.

I wish also on this occasion to answer some questions that are asked from time to time of the Secretary and President of the Association.

When the question of the organization of the Association was being discussed, it was seriously asked whether there were any good reasons for the existence of such an organization. A review of the work accomplished and a glance at the programme of the present meeting are, I trust, sufficient answers to such doubts.

If I were asked to say what one thing more than another has been instrumental in bringing about our present healthful organization, I would answer: A wisely framed Constitution and By-Laws and a strict adherence to their requirements. Let us consider some of these in detail.

Membership in the Association. There is no provision for an application for membership by the applicant himself. To become a member the candidate must be personally known to at least two members of the Association, who voluntarily nominate him for membership; and the candidate must have a creditable record of

orthopedic work, either as a writer, a teacher, or a clinician. An account of this work, accompanying the nomination, must be placed in the hands of the Secretary at least twelve months prior to the time of the regular meeting. Each candidate shall present a paper through the Secretary. The names of all candidates, with accompanying vouchers, are placed in the hands of the Committee on Admissions, who, after due deliberation, may report favorably or unfavorably, or withhold any name indefinitely for further deliberation. Any member absenting himself from three consecutive meetings, or two years in arrears in payment of dues, may be dropped from the rolls; and membership is forfeited when one ceases to take an interest in the objects of the Association, or is guilty of an unprofessional act or a public misdemeanor. Protected by such an array of safeguards, the Association has been able to maintain an exceptional standard and a continued interest in the work.

An additional assurance of something more than the usual society interest is the magnitude of the initiation fee—twenty-five dollars, and the annual dues—fifteen dollars. No lukewarm orthopedic surgeon will accept membership at this price or continue it after he has ceased to have the welfare of the Association and the advancement of orthopedic surgery at heart.

The By-Laws further provide for the publication of the TRANSACTIONS of the Association, and the generous expenditure of practically our entire income in the annual publication of these TRANSACTIONS has played no unimportant part in the development of the Society. In this line, let me urge upon you the serious consideration of the publication of a monthly, or at least bi-monthly, journal which shall contain all the papers read before the Association, and abstracts of all other worthy publications upon orthopedic subjects, whether first appearing here or abroad. Such a journal could be issued at little, if any, increase upon the cost of the present TRANSACTIONS, and in the hands of an enterprising editor could, within a year or two, be made almost self-supporting.

At the organization of the Association an effort was made to put aside all personal and sectional prejudices and invite to membership every surgeon in the country who was known to have done any considerable special work in orthopedics. This spirit has con-

tinued in the Society, and now twenty-one cities are represented by our fifty-two active members, and sixteen cities by our twenty-one Corresponding and Honorary Members. This has had no little to do in the filling of our membership with the right sort of men. What a mistake it would have been to have confined the membership to the cities of New York, Boston, and Philadelphia, where only were there large orthopedic institutions! The Association is honored by the men from the great cities, who have abundant opportunities *to see;* but it is also equally honored by the men from the smaller towns, who have time *to think.* We want among us every surgeon who has the opportunity to see that which we have not seen; every surgeon who can bring us new facts in orthopedics; and every surgeon who can read us a new rendering of the old observations which we have all helped in some measure to store up.

It has not heretofore been the duty and privilege of any President of this Association to speak to you of two great men, members of the Association, who have died. I feel myself wholly unworthy to do this. I must, however, say a few words in memory of Dr. Little and Dr. Detmold.

William John Little was born in London on August 7, 1810. He died suddenly, after an illness of ten days, on July 7, 1894, being nearly eighty-four years old. His career is a marvellous illustration of the manner in which serious misfortunes oftentimes result in the greatest benefits for those brave souls who cheerfully do the work that comes to their hands. William J. Little was never a strong child. During convalescence from one of his many illnesses he suffered an attack of poliomyelitis anterior, which left the dorsal flexors of his left leg paralyzed for life. The usual deformity resulted, to which deformity he afterward gave the name "talipes equino-varus." There can be no doubt that his disability rendered him a more studious lad, and that his deformity led him into the study of surgery. At ten years of age he was at St. Margaret's School, near Dover, and three years later at the College of St. Omer, in France. Here he won a prize for French composition, an honor never before attained by an Englishman. At the age of sixteen he returned home and was apprenticed to an

apothecary in the East of London. The practical pharmacy learned here he always considered of the greatest value to him in later life. At the age of eighteen he entered the London Hospital as a student when Andrews was already teaching the importance of a generous diet in cases of severe injury, and Sir William Blizzard, past ninety years of age, was still on the active surgical staff. Having completed the necessary studies, in 1831 he became a Licentiate of the Apothecaries' Company, and the following year was admitted a Member of the Royal College of Surgeons. Later, he attended Lectures on Morbid Anatomy by the celebrated Hodgkin at Guy's Hospital, and studied Comparative Anatomy and Physiology under Grant at the University College. He commenced practice as a surgeon, but doubtless soon learned that one does not enter upon a large surgical practice in a day in London, and that, taken with the bitter disappointment (doubtless at the time it seemed a serious misfortune) of failing in the contest for appointment as assistant surgeon to the hospital, again shaped the course of his career. In order to fit himself for any vacancy on the medical staff of the hospital he entered upon a two-years' course at the University of Berlin.

From the beginning of his medical career he had eagerly studied all that he could find that had been written upon the subject of the deformity from which he suffered; he had patiently borne the tortures of various forms of apparatus; he had had the advice of all the prominent surgeons of England, and had begged in vain for relief by operation; in Berlin, Leyden, Leipsic, and Dresden he sought advice as to submitting himself to Stromeyer's care, and everywhere was met with shakings of the head and discouragement. Michælis, as you know, had operated in 1811; Sartorius in 1812; Delpech in 1816; and Stromeyer in 1831. Now, in 1835 and 1836, Stromeyer's work was attracting attention, and, in spite of discouragement from all sides, he went to Hanover and submitted himself for operation. The result was most satisfactory, and through the kindness of Stromeyer he operated upon a patient in July, 1836. Returning to Berlin, Dr. Little treated upward of thirty cases of club-foot, and this experience, together with his pathological investigations under Johannes Müller, supplied the material for his thesis on taking the degree of Doctor of Medicine in 1837. This

thesis, *Symbolæ ad Talipedum Varum Cognoscendum*, was the first monograph on tenotomy ever published. He returned to England and, in 1839, published his treatise on *Club-foot and Analogous Distortions*. At about this time he founded the Orthopedic Institution, now the Royal Orthopedic Hospital, and was appointed assistant physician to the London Hospital, from which he retired as senior physician twenty-four years later. In 1844 he severed his connection with the Royal Orthopedic Hospital. In 1884 he ceased to reside in London, and soon after retired from practice.

For many years he was Visiting Physician to the Asylum for Idiots, at Earlswood, and to the Infant Orphan Asylum, and Consulting Physician to the National Orthopedic Hospital and the Royal Hospital for Incurables. His most important publication, *On the Deformities of the Human Frame*, 1853, contains a description of two cases of pseudo-hypertrophic paralysis, afterward described and named by Duchenne, of Boulogne. He also first noticed and classified talipes calcaneo-valgus and infantile spastic paralysis and its deformities. Section of the tibial tendons was first advocated and performed by Dr. Little.

Besides papers read before societies, Dr. Little published a treatise on *Anchylosis, or Stiff-joint*, in 1843; *On Spinal Weakness and Spinal Curvature*, in 1868; and, in conjunction with his son, Mr. E. Muirhead Little, a monograph on *In-knee and its Treatment, With and Without Operation*, in 1882.

William Detmold was born in Hanover on December 27, 1808; he died in New York on December 27, 1894, on his eighty-sixth birthday.

Dr. Detmold was educated at the University of Göttingen, receiving the degree of M.D. in 1830. Soon after this he was appointed surgeon in the army, his father, Dr. Henry G. Detmold, being Court Physician to the King of Hanover. The trend of Dr. Detmold's work toward orthopedic surgery was without doubt due to the influence of Stromeyer, who made his first subcutaneous tenotomy for club-foot in Hanover the year following Dr. Detmold's graduation in medicine.

In 1837 Dr. Detmold came to this country and opened his office in the fashionable quarter near the Battery, in New York City.

It may be said, with far more justice than is often the case with us doctors, that he commenced practice at the same time that he opened his office. He once told the writer that during his first year in New York he kept eight horses and spent all the money he knew how to spend, and yet saved from his practice nearly nine thousand dollars. He was a man of striking appearance, and in those days, when lower Broadway was the fashionable promenade, he was accustomed to drive each afternoon in an equipage of such brilliancy that no one failed to recognize and remark upon the success of the great surgeon.

His first writing upon an orthopedic subject appeared in *The American Journal of the Medical Sciences* in 1837. He was the first to do subcutaneous myotomy in this country, and although not the first to do subcutaneous tenotomy, he did more than any other surgeon to popularize that operation on this side of the Atlantic. In 1841 he established an Orthopedic Clinic at the College of Physicians and Surgeons in Mercer Street, and on this account has been called the father of orthopedic surgery in this country, although he never limited his practice or his teaching to that branch of surgery. In 1862 he was appointed Professor of Military Surgery and Hygiene, and, later on, Clinical Professor of Military Surgery.

He was a volunteer surgeon in the army during the War of the Rebellion, and was active in establishing the surgical service. How rapid and brilliant an operator he was will be understood when one is told that during the forenoon on the day following the first battle of Bull Run he amputated seventy-five limbs.

Dr. Detmold was a frequent contributor, in his younger days, to the current journals, but he never undertook any serious piece of bookmaking; he was, perhaps, too busy a man. He was a general practitioner of surgery, in the broad sense that not only included all surgical specialties, but all medical cases as well, and those of us who were privileged to attend his clinics received much good from his varied knowledge, though at that time we may have complained because he would exhibit a case of headache instead of performing some bloody operation. His lectures were always interspersed with quaint humor and practical advice. It was he who first advised always having a stone in one's vest-

pocket when cutting for stone in the bladder; and he used to advise to operate without an apron in an old pair of trousers, in order that a charge for a new pair might be included in the bill. Some of his success as practitioner was doubtless due to the generous estimate which he placed upon his services when rendered to rich men. It is told of him that one day, while walking down Broadway with another surgeon, he was asked how much he had charged for a certain trivial operation upon the person of a wealthy man. "A thousand dollars," he answered. Amazed at what seemed an unreasonably high charge, the other surgeon exclaimed: "A thousand dollars! Why didn't you make it ten thousand?" "Well, I think I will," answered Dr. Detmold, and thereupon added another cipher to the amount of the bill, and, it is said, collected the full amount.

Dr. Detmold was one of the first to make riding a fashionable recreation in New York. My last remembrance of him is of his soldierly figure on his fine horse in Central Park. There he could be seen every afternoon up to his eighty-second year.

In reviewing the record of the long and active lives and of the work accomplished by Dr. Little in England and Dr. Detmold in America, one feels that truly "there were giants in those days."

CONGENITAL ABSENCE OF RADII, WITH OPERATION.

By STEWART LeROY McCURDY, A.M., M.D.,
PITTSBURG.

Mildred G., aged five months; birth at full term. Presentation normal. Complete absence of the radii with abnormal relationship existing in the bloodvessels, with soft structures of the forearm; otherwise child perfectly developed. Operative interference was not advised for the reason that no quite successful method had been invented.

Bradford and Lovett, page 529, say: "In the worst cases, where there is much bony deficiency, the choice lies between amputation and doing nothing."

Not having in mind the method of operative procedure described by Dr. R. H. Sayre, and read before the Society at St. Louis in 1893, manipulation and mechanical support were advised.

About this time *Annals of Surgery* for February reached me, and the following may be quoted from page 238:

"'Treatment of Congenital Bone-defects in the Forearm and Leg,' by Dr. Rincheval (Cologne). Professor Bardenheuer two years ago presented a new method for the operative treatment of these deformities.

"His operation in the forearm consisted in replacing the defect, at least at its lower part, with bone, and thereby permanently correcting the deformed position of the hand.

"The operation is performed as follows, by a longitudinal incision, the distal end of the ulna and the carpus are exposed, and the first isolated from its attachments. The ulna is then split through its middle into a radial and an ulnar section. These are separated by allowing the carpal bones to come up between them.

By means of a nail through each side the ends are fixed to the carpus. A plaster-bandage is applied and left on four or five weeks.

"This operation is easily carried out. It has been done three times by Bardenheuer—twice for congenital absence of the radius in an eighteen-month-old child and in a seven-week-old baby, and once in a ten-year-old boy whose radius had been removed at its lower part for caries, leaving the hand in a position of varus.

"The results in all three cases were good, both from a functional and cosmetic point of view. In all cases the deformity was permanently corrected. The movability of the hand was almost normal. There was no disturbance in the longitudinal growth of the bone. In the first case operated upon there was a very pronounced growth of the deformed extremity a year after the operation.

"The same principles may be adopted in the treatment of other defects. In cases of congenital defects of the tibia or fibula the same operation has been done once in each. The best result was obtained in the fibular defect.—*Verhandlungen der deutschen Gesellschaft für Chirurgie*, XXIII. Kongress, 1894."

March 1, 1895, operation was done at Protestant Hospital, Columbus, O., the desire being to adhere to the method described as near as possible. It was not possible, however, to follow the method. The soft structures, tendons, etc., were so much shortened that to attempt to shift the end of the ulna across to the centre of the carpus would have been impossible, except by a virtual amputation of the arm. To split the ulna and wire the carpal bones between these ends would have been impossible.

The only method that appeared to me to be possible was to sever the ulna at a point where the free end of the upper fragment could be brought to the semilunar.

The semilunar was curetted and drilled, and after drilling the ulna these bones were adjusted with silkworm-gut. It was necessary to tenotomize the tendons, etc., upon the radial side of the forearm before the hand could be straightened. A number of arteries were severed and required ligation. The cut through the soft tissues was made obliquely across the forearm, beginning upon the dorsum of the wrist upward and around under the forearm,

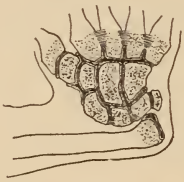
the object being to allow the structures to slide upon each other, and then sutured in the corrected position, thus avoiding the gap that would otherwise be left after a cross-section.

After dressings were applied, the hand was put up in plaster of Paris.

FIG. 1.

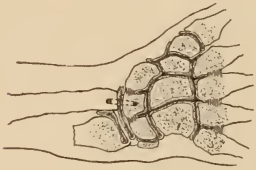
Normal wrist-joint with the five synovial sacs.

FIG. 2.



Condition existing in the arm of my case.

FIG. 3.



Relationship of the parts after operation.

FIG. 4.

Outline-drawing of the arm as furnished me by the family physician six weeks after operation.

There was quite extensive hemorrhage, and it was necessary to re-dress the arm in twenty-four hours. The next dressing was made in two weeks after the operation and primary healing had occurred.

The operation was done on the left hand, and a second operation was planned for the right arm, but the patient died with pulmonary tuberculosis five months afterward.

Such an operation would, of course, destroy the second sac of the wrist-joint, and, assuming that the third synovial sac was normal, the wiring of the free end of the ulnar to the semilunar would not destroy the third sac, and to wire with the hope of union between these bones would allow fair flexion and extension at the wrist.

FIG. 5.

Photograph of child before operation.

British Medical Journal, March 10, 1894, quotes Kronig as follows: "There are forty-five recorded cases of congenital absence of the radius, and in twenty-one the defect was bilateral. In only two were the thumb and first metacarpal bone well developed. In the great majority of cases the child was both premature and stillborn, and it seldom lived many weeks. Nearly all other defects were present in other parts of the body."

In this country Dr. R. H. Sarye reports one case. Dr. A. E. Taylor, of Philadelphia, has given me a report of one case by letter.

In this communication I desire to report another case of congenital deformity, with a decided history of maternal impression.

Mrs. S., whose husband was a railroad conductor, when about six weeks pregnant was startled by the appearance of a crowd of men with a man on a stretcher. She thought it was her husband. She has a habit (when startled or in grief) of grasping the fingers on the left hand, including the thumb, just below the knuckles, by the right hand.

While the injured man was not her husband, the impression was imparted to her unborn child. The fingers and thumb of the left hand are absent from the middle of the first phalanges.

DISCUSSION.

Dr. John Ridlon. I have sent to my office for photographs, not to show absence of radii, but simply to illustrate a point which I wish to make in regard to maternal impressions. Certainly I would take issue with the speaker in regard to maternal impressions having any effect at all upon the causation of deformity. The child whose photograph I will show you was the first child of healthy people, without deformity. The mother had no reason for supposing that the child would not be in every way normal, yet it was born with a constriction around the left little finger, with the other fingers webbed, and the second amputated and pointed. The first, third, and fourth fingers were webbed on the right hand, and the middle finger amputated and pointed. There was club-foot, equino-varus of moderate degree. Around the leg was a constriction-band three quarters of an inch deep at the back and one-quarter of an inch deep in front. In this case the mother was a very nervous woman, very much annoyed and worried over the condition. She became pregnant again with a second child, and during this time the webbed fingers were amputated by the family physician at Harvard, Ill., and the constriction-band incised in three places. The mother was instructed to rub the leg and stretch the foot twice daily. This she did during the time of the pregnancy of the second child. She expected greater deformities in the case of the second child, but it was born without any deformity at all. This case argues against

the effect of maternal impressions, and it has been in accordance with my observation during the entire time I have been engaged in treating deformities.

Dr. V. P. Gibney. There was so much noise in the room during the reading of Dr. McCurdy's paper that I failed to understand whether the results of the operation were good or not.

Dr. McCurdy. Yes, sir.

Dr. Gibney. I believe the Doctor said he did not follow the steps of the operation as laid down by Bardenheuer, but departed somewhat from them.

Dr. McCurdy. I could not follow the operation referred to on account of the great shortening.

Dr. Gibney. What was the result of the operation?

Dr. McCurdy. The drawing which I have here shows the arm not perfectly straight, but almost so.

Dr. Gibney. I think the Doctor is to be congratulated upon his success in this case, because most of these cases seem to be hopeless ones to deal with. I cannot discuss the operation which the Doctor resorted to because I failed to grasp the details of it, but I shall hope to read it when it is published in the Transactions. I should say the course pursued by the Doctor is a step in the line of progress.

Dr. Goldthwait. I would ask Dr. McCurdy how firm union he secured at the point of suturing the bones, as near as he can judge.

Dr. McCurdy. It was very fair. Relative to maternal impressions, I have no particular views in that direction, except I reported this case just as it was found. Whether it is possible in all of these congenital deformities to trace a maternal impression is a question, and in the case reported by Dr. Ridlon the mother was looking for a congenital deformity and could not

find it. Whether that would argue for or against maternal impressions is also open to discussion. It is well known that congenital deformities occur more frequently in the colored race, in children born between one nationality and another. I have a case I want to report of a child with congenital deformity of one arm, whose mother was a negress and father was a Chinaman. In making dissections of negroes we are apt to find more or less deformities existing.

I would call the attention of the Association to the report of Dr. Sayre a year ago and his case, and also to the fact that Dr. Sayre described this operation that I performed essentially before the operation described by the Cologne surgeon (Dr. Rincheval) was published in the *Annals of Surgery*. If you will look over the TRANSACTIONS, you will see that I did not carry that out, from the fact that I did not have Dr. Sayre's report in mind at the time the case came to me. Dr. Sayre should have credit for originating the method.

REMOVAL OF THE ASTRAGALUS FOR TALIPES VALGUS.

By JAMES E. MOORE, M.D.,
MINNEAPOLIS.

The modern non-operative treatment of talipes valgus is so satisfactory that it is rarely necessary to consider operative measures. In acquired flat-foot, to which I shall limit this brief paper, several operations have been tried in extreme cases.

Ogston's operation, which consists in the removal of the articular surfaces between the scaphoid and astragalus with small portions of bone, followed by nailing together, is the best known and has probably been performed more frequently than any other operation. At the present time, although a number of satisfactory results have been reported, this operation does not seem to have any very enthusiastic advocates.

The scaphoid has been removed, but has not been followed by very flattering results.

Stokes's operation, which consists in the removal of a wedge-shaped piece of bone from the astragalus, has failed to meet the indications satisfactorily.

The writer had occasion to study this subject carefully about two years ago, when the following case fell into his hands: The patient was a woman, about twenty years of age, who had cut the internal lateral ligament of the ankle when she was a child by stepping upon a piece of glass. Upon examining Fig. 1, it will be seen that the uninjured foot shows that she had a natural tendency toward flat-foot. The injured foot shows extreme flat-foot, with the inner side of the great toe turned almost directly downward. She had grown gradually worse for some years, so that when she came to me she had been obliged to give up her employment as a

domestic on account of the severe pain produced by standing or walking.

She was sent to the Northwestern Hospital, and on June 26, 1894, chloroform was administered with the hope that we might be able forcibly to correct the deformity. Owing to the extreme rigidity of the foot it was feared that we might fail, so the patient's consent was gained to resort to a cutting operation if it was found

FIG. 1.

necessary. It was found impossible to overcome the deformity by manual force, and an operation was decided upon. It was evident from the condition of the foot that none of the above-mentioned operations would overcome the deformity. The displaced astragalus formed the bulk of the deformity and seemed to be the keynote of the trouble; so I decided to remove it, which I did through a longitudinal incision in the inner side of the foot. The foot could be

immediately placed in a very satisfactory position. The usual surgical dressing was applied, and the foot held in proper position by a plaster-of-Paris bandage. The healing was prompt and satisfactory, and in about two months the patient began to walk.

As can be seen in Fig. 2, there is a marked improvement in the position of the foot, although it is far from being a "Trilby." It will also be noticed in this photograph, which was taken about one year after the patient began to walk, that the ankle which was atrophied has developed considerably.

FIG. 2.

I am pleased to report that the result of this operation is more satisfactory from a practical than from an æsthetic standpoint. The patient still complains of some pain such as we are accustomed to hear from patients suffering from flat-foot When she stands much or walks more than usual the foot is somewhat

swollen in the evening, but she is now at work. I am satisfied that much, if not all, of this pain could be avoided if the patient were not so unruly. She will persist in wearing a light-weight, high-heeled, pointed-toed shoe. While this patient is in every way better than before the operation, the result is not nearly perfect; but she has been improving quite rapidly of late, and I am in hopes that eventually she will be quite well.

Vogt has recommended excision of the astragalus for valgus, and Weinlechener exhibited a case at Vienna in which he had removed this bone for severe flat-foot, with a satisfactory result. So far as the writer knows, the case reported in this paper is the only one in the country in which this operation has been performed. As we all know, the astragalus has often been removed for extreme varus, with some good results, and it seems but natural to expect that it might be followed by equally good results in valgus. There is one important difference, however, between the two deformities, which has a bearing upon the ultimate result of any kind of treatment: while the weight of the body falls upon a perfectly corrected varus in such a manner as to prevent a relapse, the reverse is true of valgus. The principle in Ogston's operation is correct, viz., the forming of a solid arch of bone, and failures following this operation are due either to removing too little bone or to failure in securing bone-union.

While my experience in this one case is not so satisfactory as I could wish, I am so sure that the lack of proper orthopedic treatment after the operation is to blame for the remaining discomfort that I shall certainly resort to it again should I meet with a similar case. There is no operation known for any variety of club-foot which is not very likely to fail unless followed by proper after-treatment. In every instance the operation should be looked upon as preparatory to orthopedic treatment.

There is one operation that we have not yet mentioned, which is known abroad as Larabrie's operation. It consists of a cuneiform oste-ectomy of the tarsus, regardless of anatomical structures, and is practically the same operation which is occasionally resorted to on the other side of the foot for inveterate varus.

So long as we meet with some cases of flat-foot that will not yield to ordinary methods of treatment, we shall be obliged to

resort to operative treatment; but it is very evident, from our experience so far, that the operative treatment is not so satisfactory that it is likely to be resorted to in any case until it is certain that other measures will fail.

It would seem that in a majority of cases of flat-foot requiring operation a cuneiform oste-ectomy regardless of anatomical structures is most likely to meet the requirements, because in that operation the surgeon is not restricted to anatomical lines, and can, therefore, shape the foot to his liking. With this operation, too, he can secure a firm, bony arch which will not yield under the weight of the body.

DISCUSSION.

Dr. Royal Whitman. I would ask Dr. Moore what incision he made in removing the astragalus.

Dr. Moore. A longitudinal incision.

Dr. Whitman. I think for removal of the astragalus it is better to make an incision around the extremity of the external malleolus, and to displace the foot outward; then if a heavy cork-screw be fixed in the astragalus, it will aid very much in the ease with which it can be removed.

Dr. Moore. I mentioned the fact in my paper that the scaphoid had been removed a number of times, but that the reports of such operations are not eminently satisfactory. In reference to the suggestion made by the Secretary (Dr. Whitman) with regard to the point of operation, I would say that the incision on the outer side of the foot is to be preferred under ordinary circumstances; but these were extraordinary circumstances, and I was not certain of a good opportunity to remove the astragalus through the outer incision. It makes considerable difference.

Dr. Whitman. I meant to dislocate the foot inward. Cutting between the os calcis in that way one cuts the under surface.

TENDON-TRANSPLANTATION IN THE TREATMENT OF PARALYTIC DEFORMITIES.

By JOEL E. GOLDTHWAIT, M.D.,
BOSTON.

The purpose of this paper is to call attention to the possibility of furnishing better mechanical attachments for certain paralyzed or only partially paralyzed muscles as a part of the treatment of paralytic deformities. The same principles are to be employed in the treatment of deformities of other character; but it is my desire to confine this paper wholly to the consideration of the method, as it is of use in the deformities which have resulted from some form of paralysis.

When this work was commenced it was my belief that it was largely original, but upon a more careful perusal of the literature, recently made, I find that in 1881 Nicoladoni operated upon a patient and attached one of the posterior peroneal tendons to the tendo-Achillis. Since then one or two other cases have been operated upon abroad, and there have been a few cases in this country. The operation, however, as it has been done, has never received public recognition and but one work on orthopedic surgery, with which I am familiar, even mentions it. Hoffa, in the last edition of his book, mentions Nicoladoni's case almost without comment.

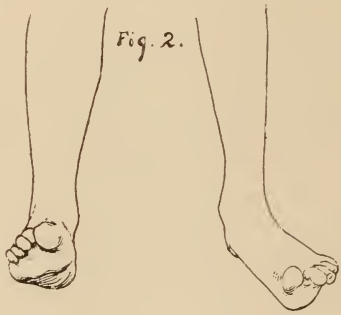
From the cases which have come under my observation it seems to me that the operation deserves a much more prominent position than it has received, and that the method is capable of much broader use. The procedure cannot, of course, cure a paralytic foot, neither is it to be applied to all cases of paralysis in which there is deformity; but in a certain limited number of cases the benefit to be derived from furnishing better attachments for the muscles is most marked. In certain partial paralyses the power which remains in

the unaffected muscles is a disadvantage rather than a benefit, as these muscles, having nothing to antagonize them, by their contraction pull the foot, or the part, out of its normal relation with the other parts; and after these normal relations are lost the deformity increases more easily and more rapidly. If in these cases some operation can be performed which will keep the bones and joints in more nearly their normal relations, improvement results. A weak muscle cannot, of course, be made to do the work of a strong muscle perfectly, but if this muscle, which has been working at a mechanical disadvantage and producing undesirable results, can be made to work in the right direction, the patient is better off than formerly. The amount of improvement will depend upon the original condition, but all of the cases which have been operated upon have been improved. It has been possible to substitute simple forms of apparatus for complicated ones, and in one or two cases to dispense with it entirely. The patients also walk better, the limp being less marked.

Thus far the operations have been performed upon the feet, but there is no reason why the same principle should not be employed in other parts of the body. At the knee, undoubtedly, it could be employed to advantage in a certain limited number of cases, and very possibly at some of the other articulations, although the best results are to be looked for in those portions of the body where the tendons are well formed and lie superficially.

The cases to be selected for the operation are those in which one group of muscles has been destroyed, leaving the antagonizing or accessory muscles little if any impaired. This condition, if not treated, results in a definite deformity, simply from the muscular activity; and this becomes more marked as the age of the patient increases, partly because of the greater weight to be borne and partly because of the greater strength of the non-paralyzed muscles. In certain cases, as the deformity develops and increases, the mechanics of motion change, so that the relation of the power to the fulcrum, and the fulcrum to the weight, or the portion moved, is entirely unlike the original condition. This is true in certain deformities at the knee, but is best demonstrated in the cases of infantile paralysis, in which all of the posterior muscles of the calf are paralyzed, with the exception of the two peroneals. The action of

these muscles normally is to extend the foot at the ankle, and to abduct, or turn out, the front part of the foot, the fulcrum being the posterior edge of the outer malleolus. There being no power in the gastrocnemius or in the muscles at the inner side of the back of the leg to control the peroneal muscles, their action gradually stretches the internal lateral ligaments and the whole foot is drawn outward. The internal malleolus becomes more prominent, while the outer malleolus is less so, owing to the turning out of the foot. Mechanically this places the outer malleolus, or the fulcrum over which the peroneal tendons act, distinctly inside the line of motion. As the result of this the tendons are gradually drawn outward until they slip over the posterior edge of the malleolus, and finally rest upon its outer surface, and in cases of long standing well toward the anterior edge. This position of the tendons is very well shown in Fig. 20, made from a photograph taken while the patient was attempting to extend the foot.

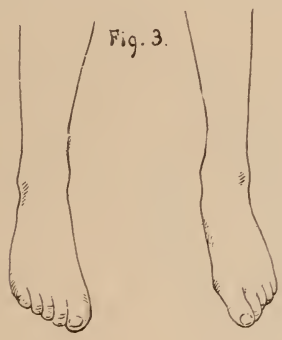


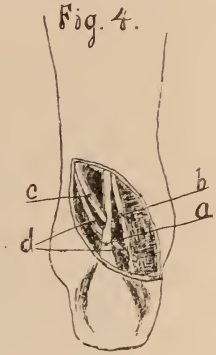
With the tendons in this position, the action of the muscles causes flexion and abduction, instead of extension and abduction of the foot, as is normal. Fig. 1 is from a photograph taken with the patient attempting to extend the feet. The right foot, which is not paralyzed, is extended normally, while the left is actually flexed as well as abducted. In this case all of the posterior muscles were paralyzed except the peroneus longus and brevis, and these tendons,

instead of being behind the malleolus, were on the outer side near the anterior edge. It is evident that in such a condition the active muscles do harm rather than good, as their action draws the foot into the worst possible position for use in standing or walking.

The best place for these active muscles to be attached would be on the inner side and directly behind the foot, as in this position the foot can be extended and the arch supported, or, in other words, the power is applied to the best mechanical advantage

In paralysis of the anterior muscles of the leg, if the paralysis is partial, those on the inner side are much more often affected, so that dorsal flexion of the foot is performed by the outer muscles, the extensor communis digitorum and the peroneus tertius. The result of this is that the foot is not simply flexed, but is flexed and abducted. This is shown in Fig. 2, and also in Fig. 19, in both of which the attempt at flexion was being made. In Fig. 2 the right foot is simply flexed, while the left foot, the one that is paralyzed, is drawn up and out.





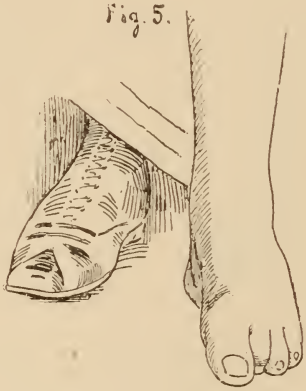
The absence of the anterior tibial, or the muscular power which is normally applied to the inner side of the foot in front, is noticed also in the action of the posterior muscles, and instead of simple extension at the ankle, extension and abduction are the result, there being nothing in front on the inner side to steady or control the muscles behind. Fig. 3 was taken with the patient extending the feet as much as possible. The right foot is extended, and, if anything, is turned in slightly, while the left foot is turned out as

well as extended. This absence of the anterior tibial muscle in walking or standing results, from the position in which the foot is placed, in a gradual giving way of the arch, and a flat-foot of a greater or less degree. Fig. 15 illustrates an extreme type of this condition. It is obvious that, in such a case, if the active muscles could be attached to the inner side of the foot the usefulness would be greatly increased.

The following cases are reported with considerable detail, as illustrative of the principles which have been expressed. Only those cases are reported which were operated upon at least three months ago, as the immediate results are of less value.

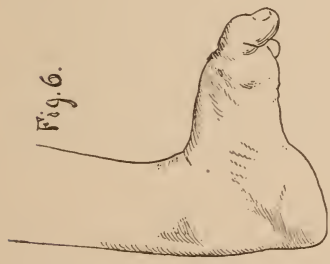
Case I.—A young woman, nineteen years old, came to the Carney Hospital in October, 1894, for treatment of the left foot. When nine months old she had an attack of infantile paralysis which involved the left foot. Walking has always been difficult, but of late, owing apparently to her increased weight, there has been considerable pain referred to the inner side of the foot, under the inner malleolus. It was because of this pain that she sought treatment.

Fig. 5.

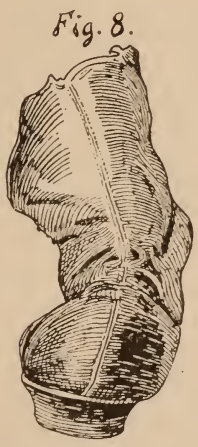


The left leg was an inch shorter than the right; there was marked atrophy of the calf; and the foot was in the position of most extreme calcaneo-valgus. In walking the weight was borne upon the inner edge of the heel, the anterior portion of the foot being turned outward fully forty degrees with the normal axis of the ankle-joint. The posterior muscles were all paralyzed, with the exception of the

peroneus longus and brevis, and the tendons of these muscles were on the outer surface of the malleolus. The anterior muscles were practically normal, and, having no posterior muscles to antagonize them, their contraction caused such extreme flexion that the dorsum of the foot rested against the anterior surface of the leg.



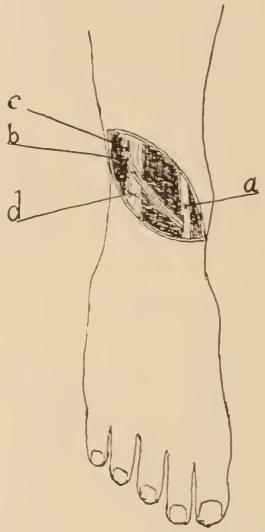
The patient was admitted to the hospital and the following operation performed (Fig. 4): An oblique incision, four inches long, was made so that it crossed the tendo-Achillis about one inch above



its insertion into the os calcis. Through this wound the peroneal tendons, *c* and *d*, were exposed and divided at about the lower edge of the malleolus. The tendo-Achillis (*a*) was then freed, and the

tendon of the peroneus brevis (*d*) was passed under this and attached to the tendon of the flexor longus pollicis (*b*). The tendon of the peroneus longus (*c*) was then attached to the tendo-Achillis (*a*), after which the wound was closed and a plaster-of-Paris bandage applied, holding the foot extended in order to relieve the strain, as much as possible, from the sutured tendons.

The wound suppurated, so that fully six weeks were required for the healing, after which the patient was allowed to walk about without apparatus. One month later, because of the tendency to pronation, a valgus-plate was applied, and this has been worn since.

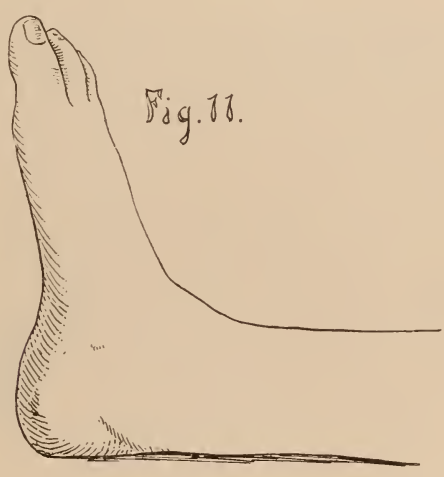


Figr 10.

The result in this case is best shown by the illustrations. Fig. 5 shows the position as the weight is borne, the turning out of the foot being entirely corrected. The extreme flexion has been controlled, only that which is shown in Fig. 6 being possible. Extension is possible, as is shown in Fig. 7, contrasted with absolutely no power of extension before the operation. The improvement in the tread of the foot is strikingly shown by the boots worn before and since the operation. Fig. 8 is from a photograph of a boot

which was worn by the patient previous to the operation. Fig. 9 is from the boot which was worn for several months after the operation. The difference in the line of the heel is very striking. Without the operation it would have been necessary for the patient to wear an expensive apparatus probably for the rest of her life. As the result of the operation she is able to get along with a simple valgus-plate, and with this she has been doing general housework for the past eight months, entirely free from pain or other symptoms.

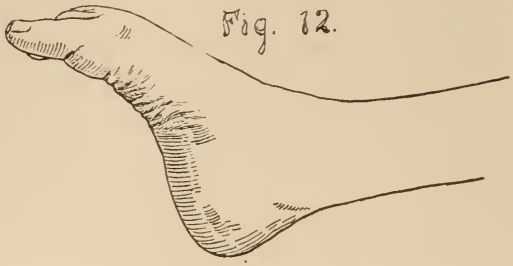
Case II.—A boy about thirteen years of age. When two years old he was paralyzed, the right lower leg and foot being the parts affected. All of the posterior muscles were destroyed, with the ex-



ception of the two peronei, and all of the anterior muscles except the peroneus tertius and the extensor communis digitorum. As the result of this, all the power being applied at the outer side of the foot, and the posterior tendons being out of place, as described in the previous case, the foot was in the position of calcaneo-valgus. Walking without a crutch or an apparatus extending to the knee was practically impossible.

The patient was admitted to the Children's Hospital, and through the kindness of Dr. Burrell I was permitted to operate upon him. The first operation, which was performed about three and one-half months ago, was practically the same as that described in Case I.

Two weeks after this a second operation (Fig. 10) was performed, this time upon the anterior tendons, in the endeavor to furnish some



muscular attachment at the inner side of the foot. An oblique incision was made across the front of the leg just above the ankle-

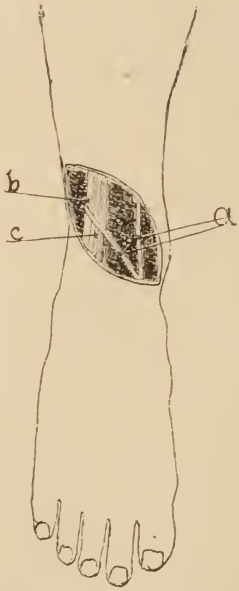


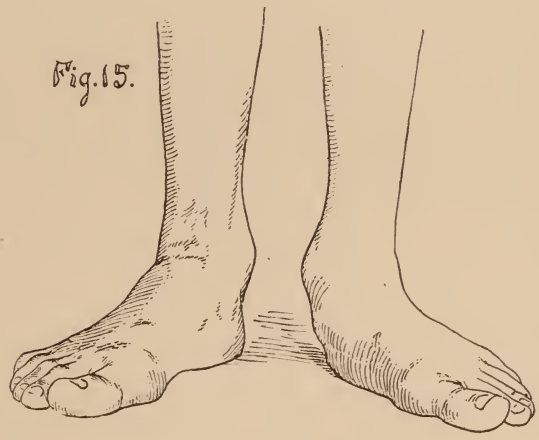
Fig. 14.

joint, and the tendons carefully separated. The tendon of the peroneus tertius (*b*) and the outer segment (*c*) of the tendon of the

common extensor (*d*) were then divided as low down as possible and attached to the tendon of the anterior tibial (*a*) muscle. The wound was then treated as in the other cases, sutured without drainage, and the foot done up in plaster of Paris for two weeks' time, after which moderate motion was allowed, the patient being permitted to walk at the end of the third week.

The result in this case is very good, the extreme valgus has been corrected, and a simple valgus-plate gives all the support that is needed. The amount of voluntary flexion and extension is shown in Figs. 11 and 12. Before the operation there was no power of extension. It is also to be noticed that the motions are pure flexion and extension, the valgus being entirely corrected. Fig. 13 shows the foot with the weight borne before the operation.

CASE III.—A boy, twelve years of age, entered the Children's Hospital in August last, in Dr. Cushing's service, and it was through his kindness that I was permitted to take charge of the case.



There was a marked valgus of the left foot resulting from an attack of infantile paralysis when two years of age. There was no contraction of the anterior tibial muscle and but slight response with the extensor longus pollicis. The other anterior muscles were normal, and the posterior muscles were normal except that there was a moderate amount of contraction of the tendo-Achillis, evidently due to the weakness of anterior antagonizing muscles. On

any attempt at flexion the foot was drawn up and out, due to the point of attachment of the active muscles at the outer portion of the foot.

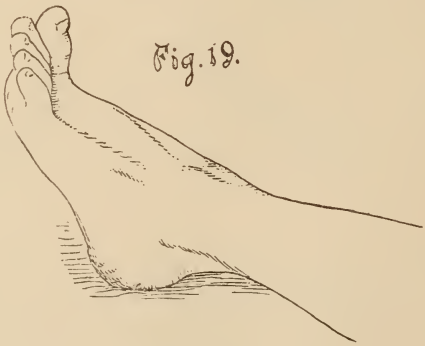
Fig. 16.

Fig. 17.

The operation (Fig. 14), which was performed over three months ago, consisted in exposing the anterior tendons as was done in Case II., and then, instead of attaching the peroneus tertius (*b*) to the anterior tibial (*a*), the anterior tibial (*a*) tendon was split and attached to the peroneus tertius (*b*). This seems to me to be a better operation, as none of the attachments of the active muscles are sacrificed, but instead another attachment for these muscles is made.

Fig. 18.

Fig. 19.



The result in this case is most satisfactory; the valgus and abduction of the foot, which were so marked before the operation (Fig.

15), have been entirely corrected, and even when all the weight is borne upon the foot the arch is high and there is no tendency to the old flat-foot. Figs. 16 and 17 were both taken with the right foot raised so that all of the weight was supported. The contrast between this and the condition before the operation (Fig. 15), in which only half the weight was supported, is very striking.

No apparatus whatever has been worn since the operation, and the child walks with the foot straight forward. On voluntary flexion the foot is drawn up perfectly straight (Fig. 18), in contrast to the flexion and abduction which were present before the operation (Fig. 19).

Case IV.—A girl, ten years of age, whom I saw at the Children's Hospital, and later operated upon, through the kindness of

Dr. Bradford. Both legs were paralyzed, the right completely and the left partially. In the left leg all of the posterior muscles were destroyed with the exception of the peroneals, and the position of these tendons was on the outer side of the malleolus, as has been described and as is shown in Fig. 20. The anterior muscles were weak, but all showed some contraction. From the position of the peroneal tendons, however, simple flexion of the foot was impossible, it being drawn up and out as is shown in Fig. 21.

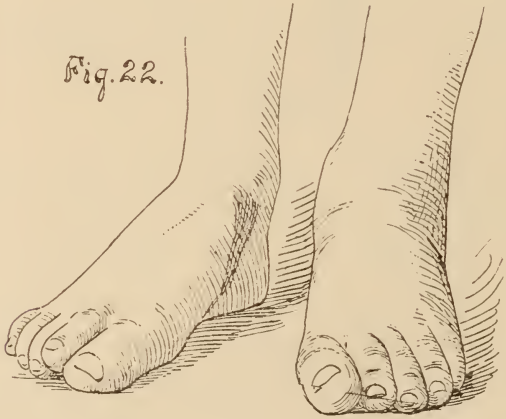
The operation, which was performed about three months ago, was the same as in the first case (Fig. 4).

The result in this case is best shown by the photographs. Fig. 22 shows the position of the foot with the weight borne; Fig. 23

shows the voluntary extension, to be contrasted with the condition before the operation, Fig. 20; and Fig. 24 shows the amount of voluntary flexion, to be contrasted with Fig. 21.

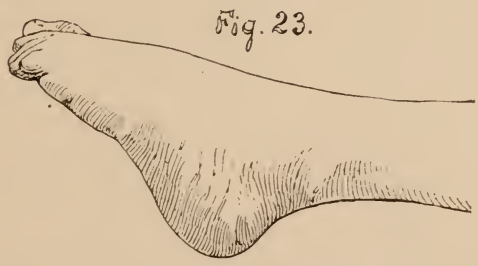
A valgus-plate is all that is necessary to keep the foot in the proper position.

The method of attaching the tendons is of great importance, and unless they are firmly joined the benefit of the operation is lost.

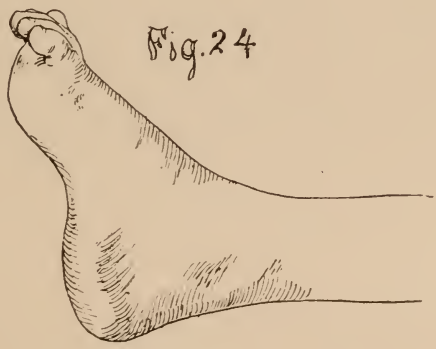


Tendons do not unite so readily as other tissues, so that it is desirable to offer as large a surface for adhesion as possible. The following method has proved very satisfactory, a method which, I

think, has not been used before. The tendon to which the attachment is to be made is split, and the end of the severed tendon, after it has been scored across to make the surface rough, is drawn through this slit and held by two quilted sutures. In this way both sides of the severed tendon become attached ; and, to offer a still greater area



for adhesion, the sutures are so placed that when tightened the outer tendon is spread out. The arrangement of the sutures is shown in Fig. 25. The outermost suture is passed through both tendons and tied. The other is passed through the outer portion of the split



tendon, then through the free tendon, from an eighth to a quarter of an inch away from the edge of the first tendon, then through the posterior portion of the split tendon, and then back in the same way. When this suture is tied it spreads the outer tendon as is shown in Fig. 26. Fine silk was the material used for the sutures.

Conclusion. The purpose of the paper is to show the possi-

bility of furnishing better mechanical attachments for the non-paralyzed muscles in the treatment of paralytic deformities.

The best results are to be looked for in the cases in which one group of muscles is paralyzed, leaving the antagonizing or accessory group unimpaired. Much of the deformity is due to the action of these muscles without the control of the other group.

Fig. 25.

Fig. 26.

Four cases are reported after at least three months since the operation. The first case, that of an adult, was operated upon over a year ago. In all there has been a marked improvement. In three cases the peroneus longus was attached to the tendo-Achillis and the peroneus brevis to the flexor longus pollicis. In two cases the anterior tibial tendon was attached to the peroneus tertius.

The tendons were attached by splitting one and drawing the other through this, and suturing them with quilted sutures.

DISCUSSION.

Dr. R. W. Lovett. I feel very much interested in Dr. Goldthwait's cases, and I have contended for some time that cases of talipes and valgus which persisted could be corrected by wearing a shoe on the outside, so that the results would be better than they are now. With all the adhesions that are supposed to have formed between the tendons and their sheaths, the results in two cases are surprisingly good and are gratifying to Dr. Goldthwait. I have seen these cases quite recently, it now being some weeks after operation.

Dr. Royal Whitman. I think one thing must be borne in mind: the relative power of the muscles. We must not expect too much from such operations; the calf muscle, for example, is stronger than all the other muscles put together, and I do not think Dr. Goldthwait would claim that its action could be effectively replaced. The tibialis anticus is also stronger than all the other dorsal flexors combined, while the extensor proprius pollicis, by which it is to be replaced, is a very weak muscle.

I do not entirely agree with him as to the normal action of the peroneii muscles. The peroneus tertius is a dorsal flexor, while the peroneus longus and brevis have but slight extending action on the os calcis.

Dr. Goldthwait. I do not wish to go on record as saying that this operation will cure the deformities resulting from infantile paralysis. In the beginning of my paper I said that we should use what power there was remaining to the best mechanical advantage. Part of the deformity is due to muscular atrophy, so that the results will not be perfect. The patients will be considerably improved. In one case the operation was performed last October, which is a long enough trial to report the improvement in the case. The other cases have been under observation a much shorter time. But this woman has worked for five months, and she gets around with a simple valgus plate. The operation has benefited the patient, the position of the shoes being a test of that.

The after-treatment in these cases is the same as that for ordinary paralytic cases. The tendo-Achilles has got to be held under control, and if there is valgus the patient must wear an apparatus that will control it.

As to the peroneii as extensors, I used the term in reference to the ankle-joint. Of course, the anterior muscles are called extensors; they extend the toes, but they flex the foot on the ankle-joint, the two posterior peroneal tendons running behind the malleolus, the malleolus being a fulcrum in extending the foot, and the peroneus longus runs across the sole of the foot and is attached to the inner side. The action of the muscle would be to produce valgus. I use extension and flexion in reference to the ankle-joint, and not as terms applied to the muscles.

COMBINATION TRACTION AND IMMOBILIZATION HIP-JOINT BRACE.

By STEWART LEROY McCURDY, M.D.,
PITTSBURG.

The indications for treatment, basing such indications upon the consensus of opinions of mechanical surgeons, are:

1. Protection of the joint and immobilization.
2. Longitudinal traction to prevent interarticular pressure.

Protection is afforded a diseased joint by either confining the patient in bed or in some portable appliance or brace that serves the same purpose. Immobilization is not given the joint with the Polyclinic, Sayre, Taylor, Judson, or Shaffer, but they all afford protection as well as traction.

Immobilization is afforded by the use of plaster-of-Paris, cuirass of Bauer, portable bed of Phelps, or Bradford and Lovett, or a Thomas hip-splint.

Traction is of the utmost importance during the early stage, to overcome muscular spasm, and, secondly, interarticular pressure, and ultimately to relieve pain, and, during the stage of dissolution of bone, to prevent shortening and angular deformity.

In order, then, to apply traction as well as immobilization to the hip-joint in disease, according to our own fancy, a combination of the long traction hip-splint and the Thomas splint has been made.

During the early course of the disease, or during the acute inflammatory process, traction and immobilization are both necessary. Later on, when the pain has subsided and the patient wants to get about, a walking perineal crutch is sufficient. During convalescence a short Sayre is all that is required. We have these three modifications in the brace I have been using for some time.

The brace complete is shown in Fig. 1. Fig. 2 shows a Polyclinic brace, which is had by removing two screws and lifting off the Thomas posterior bar, Fig. 3. Fig. 4 shows a short Sayre, the part of brace given us after the removal of the lower end of the walking-crutch, Fig. 5. This is comparatively an inexpensive brace. It is applied as the braces of which the one described is a combination are, the rules being observed as laid down in text-books.

FIG. 1.

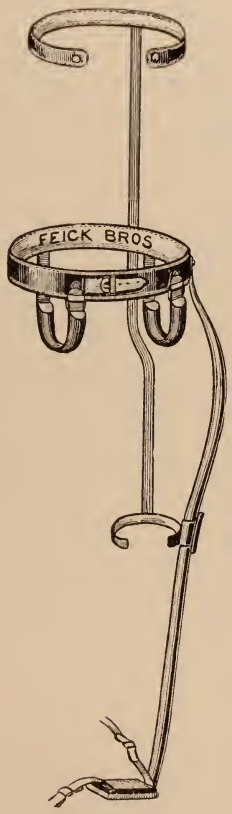
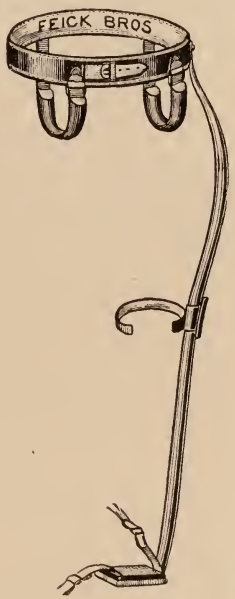


FIG. 2.



The straps, as shown in Fig. 1, I have made of a very firm quality of elastic webbing, generally. This is done to carry out the idea of elastic traction in the treatment of these hip cases upon the same principle as has been recommended by the author of this

Fig. 3.

Fig. 4.

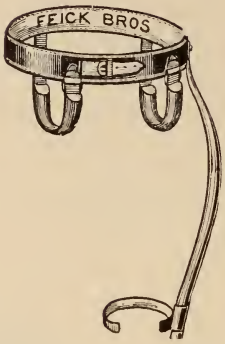


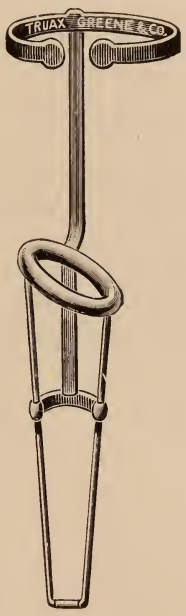
Fig. 5.

paper heretofore in the treatment of all forms of joint-disease when muscular spasm is a cause of interarticular pressure and resultant pains.

A SPLINT FOR HIP-DISEASE.

By JOHN RIDLON, M.D.,
CHICAGO.

This splint consists of a Thomas short hip-splint attached to a "caliper" knee-splint by turning the ends of the lower band of the hip-splint over the upright rods of the knee-splint and fastening



the main stem of the hip-splint to the ring of the knee-splint by a screw-clamp. The upper thigh-band of the hip-splint is omitted. Otherwise the splint presents the simple combination of the two splints above named, with which all are familiar.

This splint was first constructed to control a very severe and persistent inward rotation in a case of hip-disease, which could not be controlled by either the simple Thomas splint or the long traction hip-splint. It served not only to control the rotation, but readily and perfectly controlled the flexion and the lateral deformity. It may be applied by proper bending when there is a very considerable degree of flexion or lateral deformity. In this particular it is superior to the Phelps splint. It more rigidly and surely protects the joint from the shocks of locomotion than any of the long traction splints (except the Phelps), and it is more simple of construction and less expensive. Its chief objection is that it is not easy to apply, since, like the Phelps splint, it must be slipped on over the foot and pushed up the leg into place. The limb is held in place by a strap across the front of the thigh above the knee, and by a strip of bandage joining the ends of the chest-bands and passed over the shoulders, after the manner of suspenders, to sustain the weight of the brace.

DISCUSSION.

Dr. Reginald H. Sayre. I would like to ask Dr. Ridlon whether patients complain of any pain from undue twisting of the knee by using the foot as a lever to evert the foot.

Dr. Ridlon. No complaint has been made of pain.

Dr. A. E. Hoadley. I would like to say that I am partial to splints on the anterior part of the body. With this splint in my hand the purpose is to have fixation ; hold the limb in a proper direction, so as to get the benefits of the operation. In fact, all the qualities of the splint can be maintained and have this bar in front. Then the patient will be more comfortable. The patient can lie on the back without being padded, and the splint can be adjusted in this way (illustrating), and it will do better service than if put on from behind. Patients can step into it from the front. That is the only comment I have to make on the brace.

Dr. A. M. Phelps. There seems to be a difference of opinion as to whether we should put this splint on before, behind, or on the side. I would put it on the side. I would take the bar off, place it here (illustrating), and then it makes a lateral-traction splint. The splint we have been using during the last two years in the Post-Graduate School is essentially this with the bar on the side. The first thing to do is to immobilize the joint, restrict its normal movements; second, to protect the joint by not allowing the patient to put the foot to the ground. We should study the anatomy of the joint in these cases. I believe spasm of the muscle is one of the prime elements which destroys joints by intra-articular pressure. These muscles can be controlled by proper traction. The traction should be applied in the line of axis of the neck.

Dr. McCurdy. I have very little to say except with reference to carrying out the idea of Dr. Hoadley. In making a Thomas knee-splint more comfortable for the patient I have removed the rear portion of the iron ring of the Thomas knee-splint in patients who have to wear it for any length of time, making this soft, so that when the patients sit down they have not the iron ring to sit upon. For this purpose one may use rope or some other material, and when the patient sits down it comes in the gluteal fold, and they can sit much more comfortably and with less pain. The same idea used for hip purposes could be carried out.

A STUDY OF THE WEAK FOOT,

WITH REFERENCE TO ITS CAUSES, ITS DIAGNOSIS, AND ITS CURE; WITH AN ANALYSIS OF A THOUSAND CASES OF SO-CALLED FLAT-FOOT.

By ROYAL WHITMAN, M.D.
NEW YORK.

The function of the foot is to bear the weight of the body and to serve as a lever for its work. Normally, this weight and strain fall through the centre of the foot and are balanced there by muscular activity. If for any cause this normal relation is disturbed, the foot is thereby placed at a mechanical disadvantage in the performance of its functions, for in spite of the accommodative power of nature to disease and deformity, its mechanisms are subject to the same laws that govern other machines, a fact that must be appreciated if weakness is to be recognized and deformity overcome. If the foot, for example, is to perform its functions, its component parts must be in normal condition and held in proper relation to one another, the muscular power must be sufficient, and the strain and weight must not be too great for the strength of the mechanism. If any one of these conditions is lacking, the foot becomes unbalanced and ineffective as a lever; in other words, it loses its spring and elasticity, the ability to raise and propel the body.

When the foot ceases to act or to be used as a lever it loses the support and control of the muscles which have balanced the weight in its proper relation to it, and the attitude of passive support must be assumed, in which the burden falls on the inner side and the strain upon the ligaments. Whether this attitude is voluntarily assumed or whether it is forced upon the foot, the disuse of function

and the mechanical disadvantages to which the foot is subjected predispose to weakness and deformity.

The type and exemplification of the weak foot is the so-called flat-foot, which not only has lost its ability as a lever, but is a source of discomfort and pain when used at all.

Flat foot, when fully developed, is practically a dislocation in which the astragalus has slipped downward and inward from the remainder of the foot to which the muscles are attached; this causes the bulging on the inner side, the most noticeable and characteristic sign of the affection. When such a foot is in use it is apparent that the deformity is made up of three elements:

1. The weight of the body falls upon its inner side; the foot is in a position of valgus.

FIG. 1.

Typical flat-foot of moderate degree, illustrating the component elements of valgus, abduction, and depression of the arch.

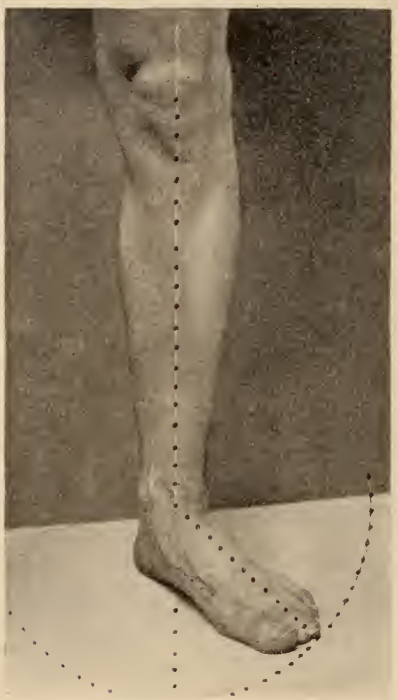
2. The leg resting on the displaced astragalus turns in; the foot turns out, so that the line of strain through which the power is transmitted to the fulcrum no longer falls through the centre of the foot, but to its inner side; the foot is abducted or everted in its relation to the leg.

3. There are broadening and flattening of the arched portion of the foot; the foot is flat (Fig. 1).

As a consequence of the displacements, the foot, considered as a machine, is twisted and out of gear, for the relation of the joint

surfaces is so changed that motion is restricted and normal muscular action impossible. The foot is weak and vulnerable, constantly exposed to overstrain and injury; thus the deformity is usually progressive and is accompanied by spasm, secondary contraction, and atrophy of muscles, and by similar nutritive and accommodative changes in the bones and ligaments.

FIG. 2.



An attitude that simulates flat-foot.

The compound deformity of flat-foot may be regarded simply as the development of the weak foot. Weak foot may be found in every grade, from the foot intrinsically strong, which is doing its work at a disadvantage because of improper attitudes unwittingly assumed, to the foot intrinsically weak or overburdened, and therefore obliged to assume the improper attitude.

As flat-foot is the further development of the weak foot, so the

weak foot is often in its appearance and function the exaggeration or improper use of a normal attitude. To illustrate this fact, let one evert the foot and bear the entire weight of the body upon it, the leg being inclined somewhat forward to bring the weight over the head of the astragalus, and an approximation to the appearance of flat-foot may be produced; the inner border of the foot becomes

Fig. 3.

Fig. 3. compared with Fig. 2, illustrates the voluntary protection of the foot from overstrain.

slightly convex, the arch is lowered, and the line of strain is displaced to the inner side (Fig. 2). Yet this and a much greater burden may be borne without a semblance of deformity if the weight is thrown to the outer side of the foot and this great toe pressed firmly against the floor (Fig. 3).

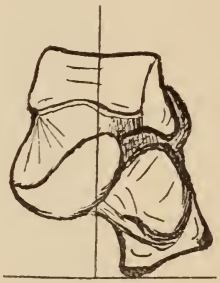
This attitude illustrates the voluntary protection in which the weight is balanced by muscular activity. In the first illustration

the strain falls on the inner, elastic, and mechanically weaker side, for the os calcis, hollowed out on its inner side for the passage of vessels and tendons, occupies a position of unstable equilibrium (Fig. 4); so that the weight of the body tends to tip it over into the flat-foot position of valgus (Fig. 5). Under the same influence the astragalus rotates downward and inward, still further increasing the instability of the os calcis. In this position the foot receives but little aid from the muscles, so that exaggeration to deformity is only prevented by the ligaments and by the shape of the articular surfaces; thus weakness may be induced by the excessive use of a normal attitude, and not only by that, as in long standing, but also by its improper use in work that demands active motion, and in which this active motion and alternation of postures, and

FIG. 4.

The relation of the astragalus to the os calcis.

FIG. 5.



The relation of the astragalus to the os calcis in flat-foot.

thus relief from constant strain, are essential to its integrity. For, although the work performed in walking is greater than that required for standing, yet long standing is the more fatiguing. The fatigue of long standing is relieved by walking, but if the passive attitude of standing, or an approximation to it, is still used in walking, the foot is subjected to constant and unrelieved strain.

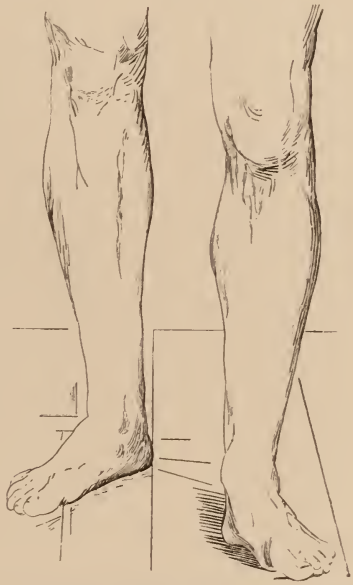
As an illustration of the protection afforded by muscular activity, the gait of one who walks properly should be noticed. The foot is advanced almost in the line of the walk, with but slight eversion, so that the weight, falling momentarily on the heel, follows the outer or strong side of the foot around to the great toe. As the leg is extended the body is raised on the foot, and as its outer

border, from the heel to the head of the fifth metatarsal bone, is shorter than the corresponding inner border, the forefoot is mechanically or involuntarily turned in or adducted, so that the weight is thrown off to the outer side at the moment of greatest strain. At the same time the muscles passing behind the inner malleolus, working to advantage, give the final push or spring to the step. The gait is elastic and graceful. There is the proper alternation of attitudes, for at every step the foot assumes the posture most opposed to passive weight-bearing and flat-foot, and at every step there is active exercise of the muscles that protect the foot (Fig. 6).

FIG. 6.

Illustrating the involuntary adduction of the right forefoot in the proper attitude.

FIG. 7.



The improper attitude of eversion of the feet.

Let this be contrasted with the slouchy, cloddy, ungraceful, jarring walk of the weak-footed or flat-footed person, in which the everted foot is lifted and set down as a lifeless mass, its normal motion replaced by exaggerated flexion of the knee, the leg never completely extended, the weight borne on the heel, the strain falling on the weakest part of the foot, and the loss of the func-

tion of leverage and the use of passive attitudes in work that demands muscular activity will have been sufficiently illustrated.

In the developed deformity, normal use of the foot is, of course, impossible, and inherent weakness of structure or other cause may make the improper attitude necessary, but just as the deformity or the weakness induces the gait and attitude, so the assumption of the improper attitude, whether by inclination or force of circumstances, may lead to and aggravate weakness and deformity (Fig. 7). The facts that such attitudes are unnecessarily assumed through ignorance or want of training, and that the weak foot may be protected in its weakness by the voluntary avoidance of postures that place it at a disadvantage, are of the greatest importance in treatment.

The safeguards of the foot are muscular activity, perfect freedom of painless motion, and normal alternations of attitude. On looking at the foot as a familiar machine, some of the common causes of limitation of its activity, its leverage, and balance will be very evident. The custom of cramping the toes in tight shoes and perching the foot on an insecure heel is certainly not conducive to the well-being of the machine.

Both the great and little toes are provided with special muscles to aid in balancing the weight, and the great toe is also a powerful brace to the arch and an aid in the work of leverage. Yet the muscles are often atrophied by disuse and the toes are distorted by compression, while the incidental corns and bunions make active motion of the foot painful, and it is avoided by assuming the passive attitude of eversion or by disuse of the active lift of the calf-muscles.

The joints of the foot may be weakened by the local effects of gout or rheumatism, or sprains or similar diseases or injuries, and the improper use of the foot necessary during the stage of actual disease or weakness may persist, either as a habit or because of more or less disturbance of structure, after the cure or subsidence of the original cause.

Distortions of the leg or fractures about the ankle may displace the weight of the body to the disadvantage of the foot, or the arch may be directly broken down, as in falls.

The foot may be overworked, as in occupations that require long standing, like those of bakers, barbers, grocers, and the like, or overweighted by the burdens put upon it.

As the foot is the mechanism subjected to the greatest strain, it is usually the first to show the effect of weakness on the resumption of work after acute or chronic disease or during childbearing.

Predisposing causes are often apparent in childhood, in general weakness and relaxation of tissues, in the inherited vulnerability and predisposition to postural deformities with which flat-foot may be associated. Weakness due to rhachitis or other forms of defective assimilation may prevent the proper use of the foot, or the weakness or deformity may be congenital. At a later period improper attitudes are common, and may even be the result of instruction, such as that of turning out the feet, a posture that interferes with effective leverage and induces an awkward, jarring walk.

The foot may be unbalanced by paralysis of certain muscles, and flat-foot may be one of the resulting deformities; but, as in such cases the cause is obvious and the prognosis and treatment are quite different, the subject does not properly come within the scope of this paper. In certain exceptional instances, however, the foot may be weakened by muscular inequalities whose cause is more obscure; but, as a rule, such cases yield very readily to proper treatment.

In estimating the relative ability of a foot from the mechanical standpoint, it will be evident that valgus must be a source of weakness, because the weight of the body is improperly distributed on the foot; that abduction is a source of weakness, because the strain of the calf muscles tends to bend the foot laterally; and that a low arch may be a source of weakness, because the lax ligaments do not hold the joints properly. These three elements combined in varying degree make up the typical flat-foot deformity, but they are by no means always combined. Valgus may accompany an exaggerated arch, and valgus with abduction is the condition often found in the so-called chronic sprain of the ankle.

Restriction of motion and improper attitudes, whether voluntary, the result of habit, or involuntary, because of pain or weakness or permanent change in any of the structures that make up the foot, are sources of weakness, because they prevent the proper alternation of attitudes. All the elements of weakness may be found in developed flat-foot, and they must be overcome before it can be cured. Any of the elements of weakness may cause symptoms of disability, and ultimately lead to deformity.

It must be very evident that the foot may be abused and deformed, and yet be able to perform its work; the predisposing causes of weakness are present, yet because little is required of the mechanism it is still efficient. It needs, however, but temporary weakness or slight injury or overwork to give the impulse, and the foot breaks down. Thus symptoms of the weak or flat-foot may develop at any age, in the robust as well as in the anæmic individual, and it is thus explained why the very evident weak and flat-foot of childhood often causes no symptoms until the period of rapid growth and increased weight of adolescence, or later, when the life-occupation is begun.

The term "flat-foot," as it is generally understood, is inadequate and misleading, in that it directs attention to a minor element of weakness and a secondary element of the deformity; for the symptoms of flat-foot do not result because the foot is flat, but because it is becoming flat; they are the symptoms of the strain upon the weak foot and of the injuries and changes accompanying a progressive dislocation. The mere depth of the arch, which varies in different races and individuals, is of small importance. An unarched foot is not graceful in outline, and it is not usually powerful as a lever, but if it is an inherited peculiarity, or if the arch has never developed, or if the acquired deformity even is no longer progressive, the individual does not, as a rule, suffer discomfort; while the normal foot, beginning to give way in abduction and valgus, may cause disabling pain before the imprint of the sole shows the slightest flattening of the arch.

The term "weak-foot" has been adopted because it implies loss of function rather than deformity, for, although the so-called flat-foot is always a weak foot, yet a weak foot is by no means necessarily a flat-foot. The term is here used in its broader sense, to include not only the deformed foot, but the various elements of weakness and deformity which may cause symptoms similar to, and ultimately lead to, flat-foot, of which the symptoms and the deformity may be regarded as the result of a disproportion between the work to be performed and the ability of the supporting structures.

This theory of disproportionate work, which includes such a variety of predisposing and exciting causes that may weaken the

mechanism on the one side or overburden it on the other, has been explained at length because of the conflicting and confusing hypotheses to be found in text-books and elsewhere, in which the effects of deformity have been mistaken for the causes, or in which a contributing or exciting factor in a special class of cases has been alleged as the primary and important element of all cases; and because the treatment to be described is conducted on the principle that the foot is a human machine that may be protected in the exercise of its functions by a knowledge of its mechanism.

If it is weak or disabled, the cause of the weakness, whether it lies primarily in the muscles or in the other component parts, may be made clear by comparing the disabled member with the normal standard. Once the cause is discovered and the obstructions to normal use are removed, the weak foot may be protected in its weakness and become a strong foot, although the conditions still exist under which it originally broke down.

The symptoms of the weak foot, though similar in type, vary in severity according to the local condition and disturbance of function, the work to be performed, and the susceptibility of the patient.

The earliest symptom is usually a sensation of weakness; the patient begins to recognize as familiar a feeling of discomfort, of tire and strain about the inner side of the foot and ankle; sometimes, after long standing, a dull ache in the calf of the leg, or after overexertion a momentary sharp pain radiating from the point of weakness; thus the patient often dates the history of his trouble from a long walk. After a time the patient may become aware that he is accommodating his habits to his feet; he rides when he once walked, he sits when he once stood, he no longer runs up or down stairs or jumps off the street car. His feet have lost their spring, as he expresses it, which means that the foot is no longer supported and controlled by muscular activity, and is no longer used as a lever. Not infrequently, early symptoms are pain and tenderness at the centre of the heel, explained in part by the jarring heel-walk which is always assumed when the foot is weak, and in part by the strain upon the attachments of the deep plantar ligaments. The patient may complain that he cannot buy comfortable shoes; the reason is, that the weak foot under use is changed in shape, so that the shoe which was comfortable in the morning compresses the foot

painfully at night, thus increasing discomfort from corns, bunions, painful great-toe joints, and deformities of the toes, is experienced. Coldness and numbness and increased perspiration, caused by the impaired circulation and weakness, are common symptoms in this class of cases.

Actual pain is, as a rule, felt only when the foot is in use; it ceases under temporary rest or relief from disproportionate work, and it is this remittence of symptoms, together with the fact that the discomfort is often more marked in damp weather, that leads to the mistaken diagnosis of rheumatism. The foot remains, however, weak and vulnerable; the patient recognizes the fact that he has what he speaks of as a weak ankle, or sprain, or gout, or rheumatism, but, as he has accommodated himself to the weakness, little discomfort is experienced.

In many instances such relief or accommodation is impossible, and it is therefore among the working class that one oftener sees the frank and rapid development of the disability and deformity. The range of motion becomes more and more restricted; the habitual attitude, at first exaggerated to deformity only under the influence of the weight of the body, remains as a permanent displacement of the bones. The weak and dislocated foot is subjected to constant injury, to what may be likened to a succession of slight sprains, so that local congestion and tenderness appear, and consequent muscular spasm and rigidity.

Because of this rigidity of the foot, which has lost the power to accommodate itself to inequalities of the surface, the patient dreads to cross a rough pavement, for every misstep is a source of pain. Another symptom which is usually present in slight degree at every stage now becomes more prominent, the discomfort felt in changing from a position of rest to activity. The patient, after sitting or on rising in the morning, is unable to walk, but staggers and limps for several minutes, a symptom explained by the fact that when the foot is at rest there is a partial reposition of the displaced bones, which must again be forced into the deformned posture that has become habitual.

The local tenderness and muscular spasm are increased by use, so that the patient may have difficulty in removing the shoes at night, and the symptoms relieved by the rest of Sunday become pro-

gressively worse during the week; the pain and discomfort are more general in character, and are often referred to the dorsum of the foot, representing muscular rigidity and tension, and to the outer side of the ankle, where the external malleolus is grinding out a facet in the projecting os calcis. The patient may now complain of discomfort in the feet and cramps in the legs, even when in bed, and the appearance of weakness, awkwardness, and depression of spirits may be so noticeable that the case is sometimes mistaken for one of incurable nervous disease.

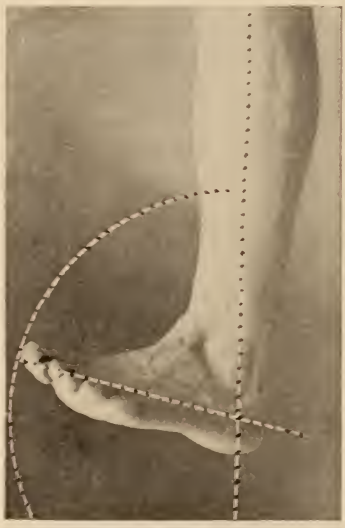
One can hardly exaggerate the pitiable condition to which the sufferer from painful flat-foot may be reduced. There is something peculiarly exasperating and depressing in an affection which prevents a person otherwise in perfect health from earning his living; and the duration of the symptoms, the mistakes in diagnosis, the ineffectiveness of treatment and the apparent hopelessness of relief, combined, have a very evident effect upon the mental and moral, as well as the physical condition of the patient. It is in this class that a definite promise of relief and probability of cure in a definite time is the best and most necessary of tonics.

If these facts are taken into consideration, that the inherited flat-foot, or that acquired in early life, or the complete flat-foot of long duration, or the weak foot to which the individual has accommodated himself, may cause no actual discomfort or pain—in other words, that there is no definite relation between the degree of deformity and the severity of the symptoms—one of the most important stumbling-blocks in the way of a proper apprehension of the true nature of the disability and its effective treatment will have been removed.

One must also rid one's mind of the notion that the weak and flat-foot is a necessary sign of degeneration, to be found only among the weak-fibred and ill-nourished. The predisposition to deformity and the weak foot in its slighter grades are perhaps as common in the well-born and well-fed as among the traditional "mill girls." The development of the deformity, the exchange of discomfort for disability, the inherited or acquired predisposition existing, will naturally be more frequent, more rapid, and more marked among those who are obliged to use the feet constantly than among those who are not.

In all cases of weakness of the foot, a thorough and orderly examination should be made of its functional ability and use, not only for the purpose of diagnosis, but in order that the amount and character of the temporary or permanent changes in structure may be estimated. One begins the examination by noting the manner of standing and walking. The heel-walk, the exaggerated eversion of the feet, the slouchy gait, in which the leg is never completely extended, in which the power of the calf muscles is not applied, and in which the essential postures of the foot are disused, are all elements of weakness, and should be corrected whether they cause symptoms or not. The distribution of the weight of the body and the habitual use of the foot are often made evident by examining the worn shoe. If it is bulged inward at the arch or worn away on the inner side of the sole it shows weakness.

Fig, 8.

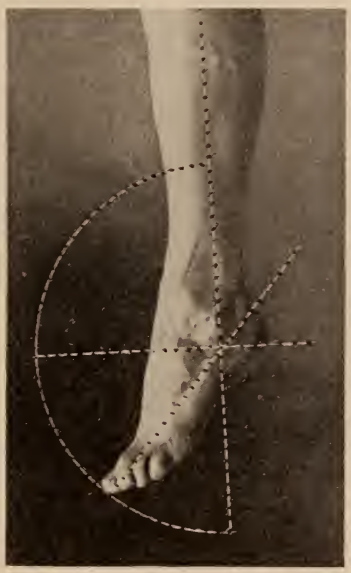


Voluntary dorsal flexion.

The same observations are then made on the bare feet, particular attention being paid to the line of strain or leverage: thus, a line drawn down the crest of the tibia from the centre of the patella, continued over the foot, should meet the interval between the second and third toes; if it falls over or inside the great toe, it shows that

the foot is working at a disadvantage. The contour of the foot should then be examined; its internal border should curve slightly outward, so that if the feet are placed side by side, with the toes and heels in apposition, a slight interval remains between them; if this slight concavity is replaced by a noticeable convexity when weight is borne, the foot is weak. This change in contour is often the earliest and sometimes the only evidence of deformity. The arch of the foot, properly protected by the muscles and by a proper attitude, sinks but slightly under weight; there is a slight elasticity only, and if the depression is marked it shows laxity of ligaments and weakness. The exact amount of bearing surface may be demonstrated by an imprint of the sole in a manner to be presently described.

FIG. 9.



Voluntary plantar flexion.

The balance of the foot as shown by the range of motion is next to be tested, for its limitation is one of the earliest signs of improper attitudes and weakness. This range of motion varies somewhat within normal limits; it is usually greater in childhood than in adult life, greater in the slender than in the massive foot, and greater in the foot used properly than in the foot that is not. The

first test is applied to simple dorsal and plantar flexion; the leg must be fully extended at the knee; the line of strain must be in its normal relation, so that the foot may be neither adducted nor abducted, and the observation must be made on its outer border. In this position, the patient should be able to flex the foot well beyond a right angle, from ten to twenty degrees. Voluntary extension can be made to about one hundred and thirty or one hundred and forty degrees, the range of motion being from fifty to seventy degrees.

Fig. 10.

Voluntary adduction.

By far the most important test is that of the power of adduction or inversion of the foot, the test of the medio-tarsal and sub-astragaloid joints, because in this motion the os calcis is drawn forward and inward under the astragalus, while the forefoot is flexed about its head. With the leg extended and the patella pointing forward, the foot is turned in as far as possible; the elevation of its inner border, or supination, and the turning in of the heel are well illustrated in the photograph (Fig. 10); the actual adduction is some-

what difficult to measure, but it is about thirty degrees. Even the mild and early cases of weak-foot usually show some limitation of this most important motion, and in many instances it is completely lost, the patient turning the entire leg in the effort to adduct the foot. The less important motion of abduction is also shown (Fig.

FIG. 11.

Voluntary abduction.

11). Its range is somewhat less than that of adduction.[1] The range of passive motion is then tested by pushing the foot in all directions. The range of dorsal flexion is from five to ten degrees beyond that of voluntary motion, while passive extension, so far as

[1] The attitude of adduction is the strong attitude, because the weak part of the foot is protected by the muscles. The typical strong deformity is the club-foot, of which pain is not a symptom, and in which the weight of the body may be made use of to correct and prevent deformity. The attitude of abduction is the weak attitude of muscular relaxation, in which the weak part of the foot is subjected to overstrain. The typical weak deformity is the flat-foot, in which the strain and weight of use cause pain and increase the deformity.

it applies to the ankle-joint, is about the same as the voluntary, although the forefoot may still be further bent downward at the medio-tarsal joint. The limit of passive adduction is considerably beyond that of voluntary inversion.

Passive motion serves several purposes; contrasted with the range of voluntary motion, it shows the habitual use of the foot, since the motion least used is most limited; it brings out the slight restrictions of motion and the presence of local tenderness, which, even in early cases, are usually present. Thus, if pressure is made just in front of and below the internal malleolus at the astragalo-scaphoid junction, and at the same time the foot is quickly inverted, the patient will notice the painful pressure-point and a feeling of constriction and tension about the dorsum of the foot before the normal limit of motion is reached. As the foot is dorsally flexed the plantar fascia is put upon the stretch, and its condition may be noted, for a contracted and sensitive plantar fascia may cause symptoms of disability that induce or are combined with abduction and valgus.

In other words, this mode of examination makes evident the amount of disability and permanent change in the machine which must be overcome before a cure can be accomplished. By it one will recognize several grades of weak-foot:

1. The normal foot improperly used, as shown by the method of standing and walking.

2. The foot in which the range of voluntary motion is restricted, showing disuse of function, and in which the elements of deformity are apparent when weight is borne.

3. That in which the passive range of motion is restricted, or in which there are evident weakness and deformity. This limitation of motion depends, as a rule, on the accommodative changes in structure to the habitual postures or to the deformity. These changes are first evident in the muscles and ligaments and finally in the articular surfaces of the bones. Added to this underlying limitation of motion there is always a varying degree of muscular spasm, dependent upon the local irritation and injury.

There can be no doubt that the origin of the weak foot may in many instances be traced to early childhood. Certainly deformities and improper attitudes are very common at this period, and it is

much more likely that they are ingrown than outgrown. Actual pain from the weak foot is rare at this age. The child may complain of fatigue and may be weak and awkward, but it is usually because of the very evident deformity rather than because of symptoms that advice is asked. In these cases, as in every case, the habitual attitudes and use of the feet are of the first importance.

One of the most frequent of the improper postures is that of exaggerated eversion of the feet, which is not only an ungraceful attitude, but a direct cause of weakness. The opposite attitude of inversion of the feet, the so-called "pigeon-toed" walk, is most offensive to relatives and friends, and it is for the correction of the attitude that the child may be brought for treatment. This attitude is in many instances a sign of the weak foot, for, on examination, the bulging on the inner side, the inversion of the leg in its relation to the foot, and the flattened arch, show very plainly that it is the foot and not the attitude that requires treatment, and that the attitude is in this class of cases really a safeguard against increasing deformity, which will correct itself when its cause is removed. Particular emphasis is laid upon this point, which is very generally overlooked, because the routine treatment of the pigeon-toes in these cases might be the cause of direct harm.

"Weak ankle" is a term popularly applied to the weak foot of childhood, in which the shoe is worn away on its inner side. In these cases the foot is in a position of valgus when in use. Weak ankles are common in very young children, and are often caused by defective assimilation. At this age the foot is, in addition, usually flat; but in the valgus or weak ankle of later years the arch is often normal in outline.

Prominent or "outgrown joints" often attract the mother's attention; the internal malleoli appear prominent because of the position of the valgus, or because of the eversion of the feet the malleoli may strike against one another, "interfere," and thus there may be an actual hypertrophy from local irritation.

Another type is the long, slender foot of adolescence, in which the scaphoid may be hypertrophied because of the strain and pressure put upon it by the improper attitudes; its position is often shown by the point of wear in the leather of the shoe. In the weak foot of childhood, although marked restriction of voluntary and passive

motion may be present, there are, as a rule, but little local tenderness and muscular spasm, and, as has been said, but little actual pain, thus differing greatly from the adult type.

The principles of the treatment which leads to the permanent cure of the weak foot and flat-foot are very simple, but their application varies somewhat according to the grade and duration of the deformity. The object of treatment is to change the weak foot, not only in contour, but in habitual attitudes and in power of voluntary motion to those of the normal foot, because a cure is impossible until function is regained. The first step must therefore be to make passive motion free and painless to the normal limit, for the obstructions to the motion of the machine must be removed before the power can be properly applied. The increase of muscular strength and ability on which ultimate cure depends is not possible while motion is restrained by deformity or pain or by adhesions or contractions.

The weak foot, because of inefficient ligaments and muscles, unable to hold itself in proper position, must in many instances be supported until regenerative changes have taken place in its structure. Such support is necessary to retain the joints in proper position, otherwise normal motion is impossible, and to hold the weight in its proper relation to the heel and the strain in its normal relation to the foot.

When these essentials are provided the patient may cure himself by the proper functional use of the foot and by an avoidance of attitudes that place it at a disadvantage.

It may be well to describe, first, the treatment that must be applied to all classes of weak foot in which a cure is to be attempted, and which by itself is sufficient in the milder types, before calling attention to the modifications that may be necessary in special cases.

In practically all cases it will be necessary to provide the patient with a proper shoe, for the shoe is usually directly the cause of the minor deformities, and indirectly, in many instances, of more serious disability.

The proper shoe should contain sufficient space for the independent movements of the toes. This motion is illustrated in the walk of the barefoot child. As the weight falls on the foot the

toes expand, and as the body is raised on the foot they contract. The important leverage action of the great toe and the support afforded the arch of the foot by it have already been mentioned.

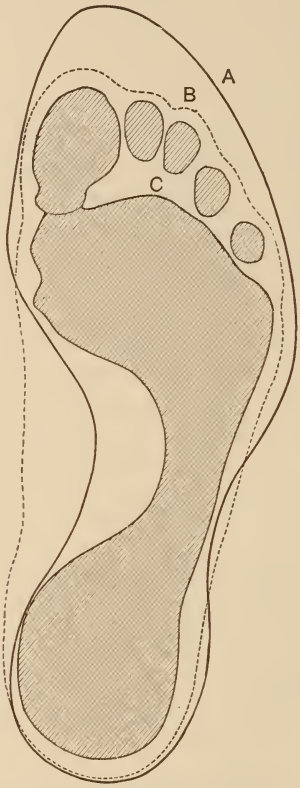
The ordinary shoe often cramps the toes into a distorted mass, so that independent motion is quite impossible. The sole of the shoe should be a protection and a support to the foot; the sole of the ordinary shoe is neither, and is of such shape that distortion of the toes is inevitable. A very good demonstration of a proper sole may be made as follows: The bottom of a normal foot is smeared with vaseline, and an imprint made on a sheet of white paper. As the weight is borne, the outline of the foot is traced with a pencil; the imprint will show the weight-bearing portion of the foot, the outline its actual size. The sole of the shoe should at least be wide enough to support the entire imprint, and ought to be sufficiently wide to include the entire outline of the foot. The ludicrous disproportion between the size, width, and shape of the ordinary woman's shoe and the imprint and tracing of the foot is often a very convincing argument in favor of a change.

If the imprint of a normal foot is made, the tracing of its outline will correspond to a slightly exaggerated waukenphast last, practically straight on the inner side, so that slight lateral motion of the great toe is allowed. There can be but one proper shape for the shoe—that which corresponds to the outline of the undistorted foot. It is not, therefore, a question of square or pointed toes, or so-called common-sense shoes, but the simple relation of the sole to the shape of the foot (Fig. 12). The wider the sole and the heel, the greater will be the stability and security afforded the weak foot as contrasted with the narrow sole and high heel.

The prevention of distorted toes and the discomfort of the abused foot is a matter of great importance in childhood. It should be insisted that the sole of the shoe be of such shape and width as to allow of independent movement of the toes. Unfortunately, little children are often seen wearing shoes of the shape usually assumed at years of discretion. In this regard girls suffer more than boys, as women do more than men. The girl who may have worn comparatively harmless shoes until the age of ten years or thereabouts changes suddenly to the high heel and narrow sole, and the process of distortion begins, the amount of distortion and

the degree of discomfort depending on the amount of work required of the foot. Wide soles and no heels should be worn as long as possible by children because of the greater security and because the high heel limits the necessity for, and therefore the use of, the entire range of motion of the foot and ankle.

FIG. 12.



The proper relation of the sole to the shape of the foot. A, outline of sole; B, outline of foot; C, imprint of foot.

A simple expedient in the treatment of the weak foot, and an aid in balancing it properly, is to raise the sole and heel of the shoe slightly on the inner side to simulate the wearing away on the outer side, as in the use of the normal foot. This aids in overcoming the valgus, and is of special importance in the treatment of the weak foot of childhood.

When the patient stands properly balanced in the proper shoe his attention is called to the three elements of weakness. He is instructed to guard against valgus by throwing the weight on the outer side of the heel; to guard against abduction by keeping the toes almost straight in front of the body; the significance of the bulging on the inner side of the foot is pointed out to him; that he must prevent this by aiding the arch by the power of the great toe, as already illustrated. The importance of leverage is shown him, that he must try to feel the sole of the shoe with his toes, and the active lift of the calf muscles by fully extending the leg and raising the body on the foot from time to time; that he must avoid long continuance in one position, especially the passive posture, which simulates the attitude and deformity of flat-foot. In short, he is instructed in the mechanics of the foot and its voluntary protection.

Although the proper walk is the best of exercises, it is important to show the patient the normal range of motion in all directions and let him endeavor to reach it by voluntary exercises. Raising the body on the toes, first on both feet, finally on one foot, for from twenty to a hundred times, is a very good exercise for the foot and for the calf. In many instances this very simple treatment is all that is necessary, and the symptoms of strain and tire completely disappear, but in cases of more severity the patient is not able to prevent deformity voluntarily, consequently a support is necessary to hold the foot in proper position and to relieve discomfort. It is usually necessary in the weak and flat-foot of childhood, because one cannot command the aid of the patient.

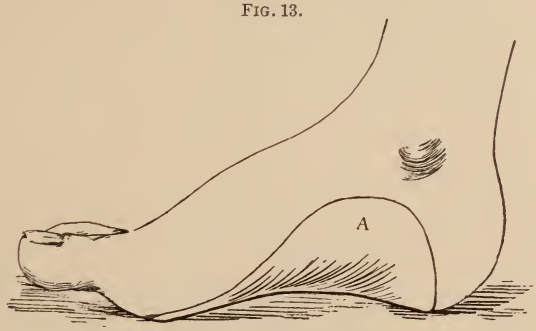
In applying a support to the weak foot the nature of the deformity that is to be prevented must be borne in mind: that the flat-foot, for example, is not a direct breaking down of the arch, as is usually taught, but a lateral deviation and sinking—a compound deformity, as has been already described—so that a brace, to be efficient, must hold the foot laterally as well as support the arch. At the same time it should not prevent the normal motions of the foot, and thus interfere with the increase of muscular strength and ability, on which ultimate cure depends. The supports that have been ordinarily used for flat-foot do not fulfil the conditions; the pads and springs placed beneath the arch are intended to support

it by direct pressure, without regard to the valgus or the abduction; they are usually ill-fitting and often of such length and shape as to splint the foot and thus prevent its motion. Leg-braces which control the valgus do not often accurately hold the foot, and their weight and unsightliness are fatal objections to their use in the early cases, in which prevention of subsequent deformity is of such importance. No brace should be applied to a deformed and rigid foot, because it is unable to shape itself to the support; the spasm and rigidity must first be relieved by preliminary treatment, as will presently be described.

The brace that has been used by me for nearly ten years was designed to meet the conditions which have been mentioned, and, notwithstanding the time and care necessary for its application, it has come into very general use here and elsewhere. On the theory that a perfect fit is essential in a brace, it has always been insisted that a plaster cast of the corrected foot should be taken in every case. Casts may be easily and quickly made in the following manner: Seat the patient in a chair; in front of him place another chair of equal height; on it lay a thick pad of cotton batting and cover it with a square of cotton cloth. Put about a quart of cold water into a basin and sprinkle plaster-of-Paris on the surface until it does not readily sink to the bottom; then stir. When the mixture is of the consistence of very thick cream pour it upon the cloth. The patient's knee is then flexed, and the outer side of the foot, previously smeared lightly with vaseline, is allowed to sink into the plaster, and, the borders of the cloth being raised, the plaster is pressed against the foot until rather more than half is covered. The foot should be at a right angle with the leg and in its normal relation to it, the sole being absolutely level with the leg, at a right angle to the floor. As soon as the plaster is hard its upper surface is coated with vaseline and the remainder of the foot covered with plaster; the two halves are then removed, smeared lightly with vaseline, and bandaged together. The interior is dampened with soapsuds and is then filled with the plaster cream. In a few moments the plaster shell may be removed, and one has a reproduction of the foot, which, when properly made, should stand upright, without inclination to one side or the other. In many instances it will be of advantage to deepen

the inner and outer arches of the cast, in order that the arch may be slightly exaggerated, especially at the heel, so that the depression and inversion of the anterior extremity of the os calcis may be prevented. This model should be reproduced in iron for an anvil, upon which the brace, cut of the best sheet steel, 18 to 20 gauge,

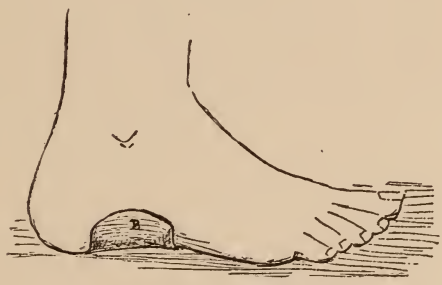
FIG. 13.



A, the astragalo-scaphoid joint.

as illustrated in the diagrams, is moulded and tempered, so that as it is applied for the purpose of preventing deformity it may be practically unyielding to the weight of the body.

FIG. 14.



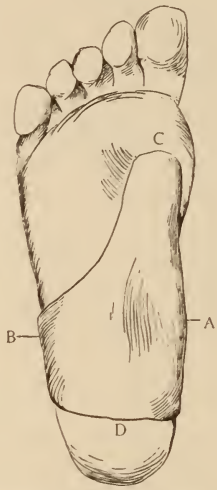
B, the calcaneo-cuboid junction.

It will be noticed that the brace clasps the weak part of the foot and holds it together; the broad internal upright portion covers and protects the astragalo-scaphoid junction (Fig. 13), rising well above the scaphoid; the external arm covers the calcaneo-cuboid junction (Fig. 14) and the outer aspect of the foot to a height sufficient to hold the foot securely; the lower portion provides a

firm, comfortable support for the sole, yet, reaching only from the centre of the heel to the head of the metatarsal bone of the great toe, it does not restrain the normal motions of the foot (Fig. 15).

This brace may be nickel-plated and japanned, which makes the smoother finish, or tin-plated, or galvanized, or covered with hard rubber, which is much more durable, as rusting is prevented. It may be covered with leather, or an inner sole may be placed on its upper surface; but this is not usually necessary. As it is fitted to the foot, it finds and holds its own place in the shoe so that no at-

FIG. 15.



C, the great-toe joint; D, the centre of the heel.

tachment is necessary; it may be changed from one shoe to another, and its presence in the shoe is not evident.

Not only does it hold the foot laterally and from beneath, but there is an element of suggestiveness in the slight leverage action which is very important. The patient, instructed to throw his weight upon the outer side of the foot, presses down the external arm, and this tightens the internal flange against the inner side of the foot, so that he instinctively draws in the weak part of the foot away from the pressure or into the normal contour; he no longer everts the foot in walking, and he is not likely to assume the passive attitude, because of the suggestive lateral pressure of

the support. The shape of the brace, in general like that of the diagram, is modified in certain cases; for instance, the entire internal aspect of the foot may be weak and must be covered by the internal flange. In very heavy subjects the sole portion must be made larger, or other slight modifications may be necessary. If any portion of the rim of the plate causes discomfort, the edge may be turned away slightly at the point of pressure by a wrench. After a few days the patient no longer notices the presence of the brace, and as it does not show, it may be worn indefinitely. It is usually necessary for from three months to a year or longer, according to the condition of the patient and the use to which his feet are put. The brace, properly made and adjusted under the proper conditions, causes no more pressure or discomfort than a well-made shoe, for its principle is quite different from that of the pads that are in common use, to which this objection has been made; the brace should afford support when necessary, and at all times suggest a proper attitude; it is, however, but one of the essential factors in a general scheme of treatment.

In the treatment of children the passive movements of the foot should be carried out to the full limit at morning and night, until the child has regained the ability to perform them voluntarily. Special gymnastics and massage are always of service, and may be necessary in certain cases. Bicycling may be cited as one of the best, and roller-skating as one of the worst, exercises for the weak foot. A year is about the time required for a cure of the weak foot in childhood, although attention to the shoes and the attitudes must be kept up indefinitely.

One may now contrast with the mild types of weakness that have been described, those cases of extreme deformity in which the symptoms are disabling and in which the foot is rigidly held in the deformed position by muscular spasm. Such cases, often considered hopeless as regards a cure or even relief, are in reality the most satisfactory, and in no other type of painful deformity can so much be accomplished by rational treatment as in this class.

The deformity must be considered as a dislocation, in which the astragalus has slipped downward and inward from off the os calcis, which in turn is tipped downward and inward and into a position of valgus.

The remainder of the foot is turned outward, so that the relation of the leg and the forefoot is entirely changed; in fact, the forefoot is almost entirely disused. With the deformity one finds, it may be local periostitis, new facets in the bones, active and passive congestion, and the like.

The amount of permanent change in the bones and in the sense of irremediable deformity has been greatly exaggerated by the few post-mortem examinations that have been recorded, for by far the greater number of patients are young adults in whom the extreme deformity is of comparatively short duration and in whom complete cure is possible.

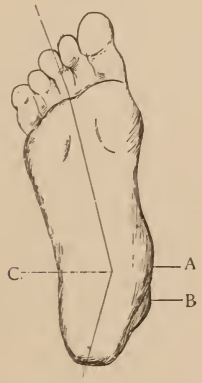
The problem in treatment, therefore, is first to replace the dislocation and to remove all the obstructions to free, passive motion, to rest the injured and congested tissues, and to relieve the sufferer from the continuous and debilitating pain. The patient is etherized and, the muscular spasm being completely relaxed, one may estimate the amount of restriction of the range of motion. Of this, muscular spasm makes about half; the aim now is to remove this residual obstruction to motion in every direction, and finally to place the foot in the attitude most opposed to that which has been habitual. This is the object of forcible overcorrection as the first step in the systematic repair of the disabled mechanism; its principle must not be confounded with forcible correction carried out with the object of remoulding the arch of the foot, or in which the simple correction of the deformity is the object in view.

One first extends the foot forcibly, then flexes it to the normal limit, then abducts and adducts, the various motions being carried out over and over until the rigid foot has become perfectly flexible; it is often necessary to allow the patient's leg to hang over the table, so that the foot may be taken between the knees, in order to supply the required force by the thigh muscles. These motions are accompanied by the audible breaking of adhesions and the complete disapperance of the deformity.

In a certain number of cases it will be necessary to divide the tendo-Achillis—when, for example, the range of dorsal flexion remains limited in spite of vigorous stretching, or when there has been very great pain and tenderness at the medio-tarsal joint, and it is desired to remove the strain of the calf muscle completely.

Traumatic cases come especially under this head. This tenotomy has one great advantage, that it lengthens the course of treatment and gives the patient the benefit of a longer rest and opportunity for after-treatment. When the passive range of motion has been regained the foot is turned downward, then inward and upward into the position of extreme equino-varus, an exaggeration of the attitude of adduction, as shown in Fig. 10. By this manipulation the os calcis is drawn under the astragalus and thrown into an everted position, and the scaphoid is flexed about and under the head of the astragalus, which is then lifted to the limit of normal flexion (Figs. 15 and 16). The attempt is always made to bring

FIG. 16.



Flat-foot before operation. A, the projection of the displaced astragalus and scaphoid; B, the inner malleolus; C, the mediotarsal joint, showing the outward displacement before, the inward rotation behind, this point.

FIG. 17.

The overcorrected foot, with the reversal of the lines of displacement.

the extreme outer border of the inverted foot up to a right angle with the leg, which is the limit of normal forced flexion in this attitude. The foot, thickly padded with absorbent cotton, is then fixed in this club-foot position by plaster-of-Paris bandages.

Surprisingly little discomfort, considering the force that it is sometimes necessary to apply, is experienced after the operation. The familiar and often intense pain from which the patient has suffered so long is entirely relieved by the correction of the deformity; there is often a sense of tension about the outer side of

the ankle and dorsum of the foot; but this is not, as a rule, of long duration. As soon as possible, often on the following day, the patient is encouraged to stand and walk, bearing his weight on the foot. Walking serves two purposes—to still further overcorrect the deformity and to accustom the patient to a posture entirely diffrent from that so long assumed.

Meanwhile the contracted tissues on the outer side become thoroughly overstretched, the weakened ligaments and muscles on the inner side are allowed to contract, and the local irritation rapidly subsides under the rest from the constant injury to which the foot has been subjected.

The patient is not confined to the bed or house; if both feet are in plaster bandages, crutches are of course necessary. The time that the feet should remain in the overcorrected position depends upon the duration of the deformity and the severity of symptoms; this is from one to six weeks, the usual time being about three weeks.

At the end of two weeks, or whenever the patient can support the weight on the plaster bandage without a sensation of discomfort, it is removed, the foot placed in the proper position, and a cast taken for the brace. Immediately after this is done, the foot is returned to the club-foot position and the plaster bandage reapplied. When the brace is ready, the plaster bandage is finally removed; the foot is now in good position, and in many instances the arch is exaggerated in depth.

For the first few days, prolonged soaking in hot water, with subsequent massage at intervals during the day, will be found useful in overcoming the swelling and local tenderness that may remain. It is always insisted that a new shoe of the waukenphast pattern shall be obtained, the sole and heel of which are raised a quarter of an inch on the inner side, to aid in the balancing of the weak foot; the brace is then applied, and the patient is never allowed to walk without its support. When the shoe is removed he is instructed to walk on the outer side of the foot or the toes until the foot again becomes strong; in other words, the deformity is never allowed to recur.

The systematic treatment is then begun by the surgeon and patient, the first essential being the attainment of free and painless

passive motion in all directions. These motions, which have been so long restrained by deformity, cannot be regained without effort, and during this stage the treatment must be carried out by the surgeon himself; if he trusts to the patient or his friends, a cure is out of the question. At least once a day the full range of motion must be carried out to the normal limit.

Three motions—abduction, flexion, and extension—are usually free and painless; but the fourth, that of adduction, is almost invariably resisted by the same quality of muscular rigidity that was present before the operation. By far the most effective method of overcoming this resistance is conducted as follows: The patient is seated in a chair and the surgeon stands in front of him. Let us suppose that the left foot is to be adducted, or, as the patients express it, twisted. The surgeon places the foot between his knees; his left hand encircles the heel, the fingers grasping the projecting os calcis and tendo-Achillis; the ball of the palm lies against the medio-tarsal joint on the inner aspect of the foot; the right hand grasps the outer side of the forefoot and toes; then, by steady pressure of the thigh muscles, the forefoot is forced downward and inward over the fulcrum formed by the projecting palm which lies upon the left knee, the fingers holding the heel steadily in place. This inward twisting is at first resisted by a mixed voluntary and involuntary muscular spasm, which gradually gives way under steady pressure. When the limit of adduction has been reached the foot is firmly held until all pain has subsided, when the patient is instructed to make voluntary movements while the foot is in the corrected position, flexion and extension of the toes, and to contract the flexor muscles of the foot. Finally the patient attempts to adduct the foot, the surgeon supplying the power, which in all cases of this type has been completely lost.

This passive manipulation from time to time to the extreme limit of normal adduction is necessary until there is no longer any sensation of pain or tension, for as long as there is the slightest spasm or painful restriction so long is the voluntary motion limited, cure delayed, and relapse of deformity probable.

During active treatment the patient by the use of massage, active and passive motion, is constantly working to one end—namely, to regain the lost power of voluntary adduction.

The time necessary to rest the feet, to overcome the local inflammation and muscular spasm, and to regain, in part at least, the range of passive motion, to place the patient in the same position as regards a cure as that of the milder type of deformity, is from three to six weeks.

Usually the patients are told that a month will be necessary, and that at the end of that time they may return to work, free from pain and from the danger of relapse, and that the feet will constantly grow stronger under the work which was before too great for their strength. The time necessary to re-educate the adductor muscles in their proper function depends in great degree upon the intelligence and persistence of the patient. Although in after-treatment massage and special exercises are of benefit, the essentials are very simple; they are an effective brace, a proper shoe, and the passive manipulation which has been described until its object has been attained; the proper walk, the best and easiest of exercises; and, lastly, to force into the patient's understanding the method of protecting the weak foot by the alternation of strain and by proper postures.

There are other cases in which the deformity of flat-foot is complicated by rheumatoid arthritis or chronic rheumatism, of which the evidence is seen in various joints, but in which the pain and discomfort seem concentrated in the feet, which are absolutely stiff and deformed. In such cases one can hardly expect a complete cure; but, although the function of leverage may not be regained, still one may hope, by overcoming the deformity, to hold the weight of the body over the foot, so that the pain of a progressive dislocation may not be added to the pain of disease.

I have in a number of instances performed forcible over-correction with the happiest results, the improvement in the general condition, consequently in the resistance to the disease after the relief of the local pain and discomfort, being very marked.

Another type of weak foot is the common variety known as chronic sprain of the ankle, to which I have called attention under the title persistent abduction,[1] in which the foot is rigidly held in an abducted or pronated position. The local condition in these cases

[1] New York Medical Journal, October 11, 1890.

varies from simple limitation of motion and slight deformity to subluxation of the astragalus; it is simply a variety of the weak and disabled foot, and is to be treated in exactly the same manner as the rigid flat-foot and with the same success. In most instances the so-called chronic sprains will be found to yield very readily to treatment conducted on the principle of an impaired function to be regained.

Between the two classes of cases, the mild and the severe, one finds every grade of deformity. All cases in which there is marked muscular spasm, local tenderness, and swelling, require temporary rest—in many instances, simply rest of function, combined with massage; in others, rest in a plaster bandage in an inverted position. In the milder and ordinary class of cases, the use of a brace and shoe will alone relieve spasm and pain, and the range of motion can usually be regained by manipulation, passive motion, and the proper use of the foot. Occasionally, even in childhood, limitation of normal motion which is not due to pain may prevent the proper use of the foot, and, if it does not readly yield to manipulation or mechanical stretching, tenotomy should be performed and followed by prolonged overcorrection of the deformity. The origin of the muscular inequality may very probably be in some instances an unnoticed and rapidly cured anterior poliomyelitis, which is still sufficient in its effects to unbalance the foot, and in others it is the result of the long duration of the deformity, but, whatever may be the theory of its causation, it is again emphasized that obstruction to motion in every direction *must* be overcome before a complete cure is possible.

It must be apparent that in many instances the cure of the weak foot is out of the question, either because of the want of energy or opportunity on the part of the patient, or because of the local or general condition, types familiar in out-patient practice. In such cases, raising and strengthening the inner side of the shoe by the wedge-shape leather sole, as used by Thomas, splints the painful foot and aids in relieving the strain. If the symptoms are more acute, the adhesive-plaster strapping, as advocated by Cottrell and Gibney for the treatment of sprains, is often of service, although it is applied in a different manner and with a somewhat different object in view. One end of a strip of adhesive

plaster, about fifteen inches long and three inches wide, is applied to the outer side of the ankle just below the external malleolus; the foot is then adducted and the band is drawn tightly beneath the sole and up the inner side of the arch and leg, and is stayed in this position by one or two plaster strips about the calf. Narrow plaster straps are then applied about the arch and ankle in a figure-of-eight manner, and a bandage is applied. The object of the dressing is to aid in holding the foot in the proper position by the support and suggestiveness of the plaster, and to provide the firm compression about the arch that is always agreeable to the sufferer from weak foot. This treatment, combined with the built-up shoe, is often very effective in overcoming the acute and disabling symptoms of the weak and injured foot.

The various cutting operations for the relief of flat-foot do not call for extended comment in a paper devoted to its prevention and cure. The typical operation aims at removal of deformity only; functional cure is made impossible by the destruction of the mediotarsal joint. It hardly seems possible that adhesion between the astragalus and scaphoid bones can for any length of time withhold a recurrence of deformity of the nature and origin of flat-foot, and in all cases that I have examined in which this operation had been performed there was still local tenderness and muscular spasm, and even relapse of the deformity.

The operation of advancement of the extremity of the os calcis, as proposed by Gleich, in order that it may be placed in relation to the leg somewhat like that of a Pirogoff amputation, is not likely to be adopted, nor is the scoring of the sole of the foot with the hot iron likely to become popular, as advocated by Bond, for the purpose of obtaining scar contraction.

The most innocent and rational of the operations for flat-foot is the supra-malleolar osteotomy of Trendelenburg; it is, unfortunately, by no means always successful, and the necessarily pronounced artificial bowleg is likely to prevent its extended use in this country.

In all operations the element of rest necessary for weeks or months must be taken into consideration as explaining the immediate effect of whatever procedure is adopted. An investigation of final results will prove, I believe, as might be predicted from the

nature of the deformty and the complex structure of the foot, that there is no short and easy method by which a cure may be attained.

A brief analysis of a thousand cases of so-called flat-foot may present certain points of interest. No cases of incidental or paralytic flat-foot are included in the statistics, which represent the new cases treated in the out-patient department of the Hospital for the Ruptured and Crippled during the past five years :

THE AGE AND SEX OF THE PATIENTS.

Age.	Males.	Females.	Total.
Ten or less	68	30	98
Ten to fifteen	112	87	199
Fifteen to twenty	144	83	227
Twenty to twenty-five	94	53	147
Twenty-five to thirty	68	41	109
More than thirty	132	88	220
	618	382	1000

Foot affected : right, 133 ; left, 138 ; both, 729.

In fifty-eight cases the cause of the disability appeared to be injury, and in sixty-five instances it was apparently due to rheumatism or rheumatoid arthritis.

The symptoms usually appear first in one foot, and, as a rule, they are at all times more marked on one side. In five hundred and sixty-nine instances, the duration of symptoms was recorded, being six months or less in four hundred and nine.

The age of the patients is of interest as bearing on the question of prognosis. Four hundred and twenty-six were between ten and twenty years of age, and seven hundred and eighty were less than thirty.

Hospital statistics cannot adequately represent the subject of the weak foot, for, as a rule, it was because of disability and pain, not for the deformity or for the milder type of symptoms, that these patients applied for treatment. In the larger proportion muscular spasm and rigidity were present, and in two hundred and thirty-fonr cases to such a degree that forcible overcorrection was advised, an operation rarely necessary in private practice.

It is in childhood that the prevention of subsequent weakness and deformity is of the first importance, yet but ninety-eight children of ten years of age or less are recorded, and of these a large proportion were brought, not for weakness or deformity, but for treatment of the symptomatic in-toeing.

The philosophy of this theory of the cause and cure of the weak foot may be again briefly outlined:

1. The normal foot may be made to assume an attitude resembling that of the so-called flat-foot (Fig. 2).

2. The deformity of flat-foot is a permanent exaggeration of a normal attitude (Fig. 1); it follows, then, that the habitual assumption of the simulating posture predisposes to deformity.

3. This passive attitude that simulates deformity may be simply the result of habit; but, on the other hand, it must be assumed if the mechanism is weak or overburdened, or if leverage causes pain, or if normal motion is in any way restricted.

4. Weakness may be prevented by guarding the foot from injury and improper use. Deformity may be cured by the removal of obstructions to normal use, by protecting the foot during the period of weakness, and by restoring the normal balance between the work to be performed and the ability of the mechanism. In conclusion, the following points are again emphasized. Flat-foot, in its surgical sense, is a compound deformity, of which the elements of valgus and abduction, the improper distribution of the weight and strain, are of vastly greater importance than the depth of the arch.

The weak and flat foot can be cured, but only by the application of the simple principles that any mechanic would apply to a disabled machine whose structure and use were known to him; in other words, there can be no permanent cure of weakness and deformity unless normal function is regained, nor effective treatment unless it has this end in view.

The term weak-foot has at least this advantage, that it implies nothing that the student must unlearn, for, if functional weakness is recognized, its causes may be analyzed and appreciated; it is because of the misapplication and misapprehension of the term flat-foot, and because of the associations which have so long ob-

secured the rational treatment of the deformity, that the term has been discarded from the title of this paper.

Previous articles on this subject by the writer may be found in the *Boston Medical and Surgical Journal*, June 14 and 21, 1888; vol. i. of the TRANSACTIONS OF THE AMERICAN ORTHOPEDIC ASSOCIATION for 1888; the *New York Medical Journal*, May 17, 1890, October 11, 1890, and February 27, 1892; and the *Annals of Surgery*, January, 1893.

THE AFFECTIONS OF THE ARCH OF THE FOOT COMMONLY CLASSIFIED AS FLAT-FOOT.

By R. W. LOVETT, M.D.,
BOSTON,

AND

JOHN DANE, M.D.
BOSTON.

The present paper must be considered as a preliminary one and not as a full discussion of the question of flat-foot. It is the desire of the writers to call attention to certain subdivisions which might profitably be made in those anomalies of the arch of the foot which have heretofore been for the most part spoken of as flat-foot, to note certain imperfections in the methods of studying these conditions, and to mention some methods of treatment which have been found of use. The study of the conditions presented in this paper must necessarily be desultory and incomplete, but so large was the field opened by the line of investigation taken up that it seemed best to offer for your consideration the points already elaborated, and to ask your assistance in the further working out of the problem which is presented. The treatment of the severe cases of flat-foot which has been so ably discussed by Dr. Whitman will not be considered in this connection.

The Foot at Birth. The foot of the infant at birth is not flat, although it is so described even in modern anatomies.[1] At birth the arch is in reality well formed, and the scaphoid lies from 1.5 to 2 cm. above the plane of the heel. (Fig. 1.) The tracing of the foot of a premature infant of seven months and the photographs of the foot intact and dissected have been described by one of the writers in Dr. Rotch's work on *Pediatrics*. The tracing of the foot of an

[1] Walsham & Hughes. Wm. Wood Co., New York, 1895.

infant premature at seven months raised in an incubator shows an arch of nearly the adult type, and the scaphoid lies 1.8 cm. above the level of the heel.

It seems as if after birth there formed under the arch of the foot a pad of fat which is apparently nature's mode of preventing the arch from breaking down. The real arch is not lowered and the scaphoid is above the plane of the heel, but the foot appears flat if an imprint is taken of it on account of the development of this

FIG. 1.

Ordinary type of foot imprint in infants.

FIG. 2.

Type of tracing in thin infant one year and eight months old.

pad. It would seem as if for the first year or two nature provided this mechanical cushion to support the arch. In thin children the imprint of the sole at this age is not that of flat-foot, but of the normal adult arch. (Fig. 2.)

At four or five years the fat is absorbed and the arch again appears in the imprint tracing. A tracing convex on the inside points to the existence of a real valgus or flat-foot. In short, the normal foot in children exhibits at birth a well-formed arch as shown by the tracing. From two to four years of age in fat children, the tracing is that of a foot apparently flat. At four or five years of age the arch should appear again in the tracing.

THE STUDY OF THE ARCH. (Fig. 3.) The study of the arch of the foot and its variations from the normal have been for the most part made by a study of the imprint of the foot as shown upon a piece of smoked cardboard, or by the imprint of the wet sole on a piece of paper or upon the floor. It is our particular object to call your attention to the fact that this method of studying the breaking down of the arch of the foot is a very imperfect one and subject to wide error, for the reason that certain grades of a painful affection, ordinarily called flat-foot, may entirely escape detection.

For example, take such a case as the following: Female, twenty-seven years old. Pain after being on feet constantly, which has lasted two years and extends to the knee and hip. It has been so severe that there is much swelling of the feet at times. Inspection shows plainly enough what we may speak of as pronation of the

Fig. 3.

Type of tracing described as normal.

foot, that is, prominence of the internal malleolus and rolling out of the foot (in relation to the leg), but the smoked tracing shows an imprint which anyone would consider normal. (Fig. 4.) This patient was then photographed in the following way: A long-exposure plate was used, and for the first half of the exposure she stood with the muscles all contracted to hold the foot in the correct position (that is, with the line of the leg passing through the second metatarsal). In the second half of the exposure the foot was allowed to assume its natural position. It may be seen by looking at this photograph that there are two distinct positions, one with the foot

in the normal position, and the other with the foot in the pronated position. With pronation is (Fig. 5) necessarily associated anatomically, as may be seen in the picture, an abduction of the for-

Fig. 4.

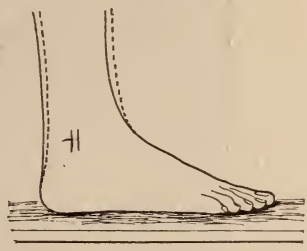
Tracing of pronated and painful foot.

ward part of the foot. Here, then, is a case of painful difficulty in the foot accompanied by a marked degree of pronation at the ankle-joint which is not shown by any abnormality of the smoked tracing.

Fig. 5.

Outline drawing of foot (from photograph) in normal and pronated position, showing inward excursion of internal malleolus.

Fig. 6.



Outline drawing of foot (from photograph) in normal and pronated position, showing forward excursion of mark over external malleolus in pronated position.

The excursion made by the internal malleolus when the foot gives way under these circumstances was measured in some cases. In the case of a male, twenty-eight years old, who had pronation

of the foot for a year, and where, under fatigue and constant overwork, a painful condition was rapidly developing, the measurement was made. The foot was placed against an upright without weight-bearing. The distance from the upright to the internal malleolus and the scaphoid was measured. The weight was borne upon the leg, and the measurement was made again in the pronated position. Every care was taken to have this measurement accurate, and it was found that the internal malleolus fell in 0.8 cm., while the internal surface of the scaphoid fell inward 0.7 cm. Measurements of value could not be taken from the external malleolus because, as shown in the photograph of this patient, the external malleolus travels forward with the pronation of the foot. (Fig. 6.)

FIG. 7.

Tracing of a "flat-foot." No symptoms; foot perfectly useful.

To study abnormalities of the arch of the foot by means of the smoked tracing alone is as if one were studying typhoid fever with a thermometer which did not register below 101°. This would be

quite sufficient to detect the severer grades of fever, but it would entirely overlook slight rises of temperature.

This condition should be spoken of as "pronated foot." It is not flat-foot because the arch has not broken down, and it would seem best to reserve the term "flat-foot" for cases where the imprint of the foot showed a real lowering of the arch. (Fig. 7.)

It would be very desirable to find some means of measuring this pronation. Possibly estimating the height of the internal malleolus from the ground in relation to the length of the foot may be of use in the future. So far the writers have been unable to devise any satisfactory method of mathematically estimating this condition. In the experience of the writers, the pronation of the foot is the only element that seems to bear relation to the amount of pain in practically all troubles with the arch of the foot, whether the arch is broken down or not, and to the study of this they would beg to direct attention rather than to imprint tracings.

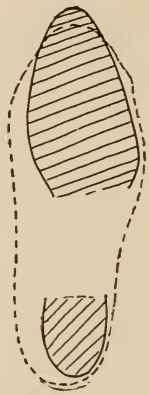
Symptoms. The symptoms of pronated foot and flat-foot are the same at the onset. The pain and other symptoms vary more in relation to the amount of pronation than in relation to the breaking down of the arch. This fact has been overlooked. The earliest symptom is generally to be found in weariness and discomfort on long standing. The feet feel hot and flushed and may prickle. The patient is obliged to spare the feet, and there is often difficulty in getting boots to fit. Pain is the commonest symptom; it comes on after standing, and it may radiate up the leg and thigh. It is confined to no especial location. Sensitive spots are generally present. The veins become enlarged and the feet sweat profusely. After resting, the feet often feel stiff and clumsy. Patients begin to walk with the feet everted and tread over the inside of their boots. The gait is clumsy and lacks elasticity. Swelling of the feet and legs may occur, and abduction of the forward part of the foot is rendered likely. Other symptoms which may be present are backache, and sometimes discomfort in the knees, especially in neurasthenic patients; pain and inflammation in the metatarso-phalangeal joint; ingrowing toe-nail and sometimes bunion. Tenosynovitis of the tendons in front of the external malleolus is a common symptom, especially in rheumatic patients.

CAUSES. The causes of pronated foot and flat-foot are the same, and will be considered together. Pronated foot, although most often an early stage of flat-foot, is not necessarily so. In general terms it may be said that either deformity is caused by a disproportion between the weight to be borne and the muscular power which bears it. The occurrence of the deformity is rendered more likely by the shape of modern boots. The immediate causes of these two conditions are the following, in the order of their approximate importance:

1. Bad boots. The most fruitful cause of pronation of the foot is undoubtedly to be found in the use of improper boots. (Figs. 8 and 9.) Merely to illustrate the sort of boots that are being

FIG. 8.

FIG. 9.



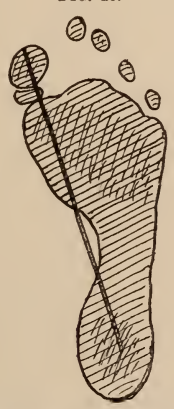
Feet and boots; tracing; the boots are shaded.

worn, the writers would submit the above tracings taken from certain young women applying for the position of nurse at a hospital where they are under the inspection of one of the writers. In each case the foot was placed on the ground and weight borne upon it and an outline in pencil was drawn around the foot. The boot was then placed upon the same paper and the outline of the boot drawn in another color. The diagrams illustrate the relation between the sole of the foot and the sole of the boot. They are not extreme instances and represent merely average tracings selected from about one hundred at the writers' disposal. They illustrate only the sort of boots that are being constantly worn, which

must necessarily do much harm. They do harm by throwing the big toe out, crippling the foot not only by squeezing the metatarsal bones together, but by impairing the usefulness of the flexor longus hallucis, which can only work to proper advantage when the big toe is in line with the inside of the foot. This displacement outward of the great toe deprives the foot of its legitimate inside support and the support which should keep it from rolling over and pronating.

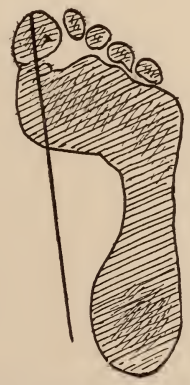
In a perfect foot Meyer's line (Fig. 10) should pass through the central point of the heel. This line is a prolongation backward of

FIG. 10.



Meyer's line in normal foot.

FIG. 11.



Meyer's line in average foot.

the long axis of the great toe. One hundred imprint tracings were taken from applicants for the position of policemen and firemen, by the kindness of Dr. Morton Prince, at the office of the Civil Service Commission, and they were studied with regard to this position of the great toe. The applicants were naturally from the middle class, where the men were likely to have worn large boots and to have been as likely to develop the normal foot as any class in the community. (Fig. 11.) Yet in no one of the cases could a line be drawn back from the great toe which would have fallen at the central point of the heel. In a series of one hundred tracings of nurses, the deviation of the great toe was still more noticeable. If one reflects upon the symmetrical boots which children wear, with the inside and outside edges alike, it must be obvious that this

process of displacing the great toe outward begins in early childhood. It is to this matter that we would especially call your attention in speaking of boots, as it seems as if modern footwear deprived the foot of a legitimate support and favored the position of pronation.

2. Weakness or insufficiency of the muscles resulting from—
   a. Long standing, especially on hard-wood floors.
   b. Rapid growth.
   c. Poor health and debility.
   d. Convalescence from acute illness.
   e. Rapid gain of weight.
   f. Accident or injury causing disuse of limb.

3. Excessive weight-bearing, as in the case of professional strong men and jumpers.

4. A shortened condition of the gastrocnemius muscle as described by Shaffer. Unless dorsal flexion of the foot beyond a right angle is possible, it is impossible for a person to complete the step with the leg straight behind him and the feet pointing forward. Eversion of the foot is necessary, and a completion of the step by rolling over on to the inner side of the foot. This, of course, tends to produce pronation and breaking down of the arch.

5. Rickets, for the most part to be observed among children.

6. Infantile paralysis.

7. Direct traumatism.

8. Locomotor ataxia and similar organic nervous diseases.

Pronated foot and flat-foot coexist often with rheumatoid arthritis and neurasthenia. There is also a type of intractable flat-foot seen in young adults, accompanied by muscular atrophy, where treatment is of little avail. Its etiology is most obscure.

Contracted foot is the term which the writers would apply to a condition described in part by Dr. N. M. Shaffer, under the name of "non-deforming club-foot." Contracted foot is characterized by a limitation of dorsal flexion of the foot and by an elevation of the arch of the foot so that the outer border does not rest upon the ground. The latter condition is made evident by an imprint tracing (Fig. 12), the former by passive manipulation of the foot with the leg held straight. Contracted foot may or may not produce pronation of the foot, and in many instances is probably an early stage of flat-foot.

The symptoms are similar to those of flat-foot: Pain and discomfort in the foot on standing, and particularly on walking; pain often located between the fourth and fifth metatarsals, and spoken of as Morton's disease; pain in the knees, and backache, are among the common symptoms.

FIG. 12.

Tracing of "contracted foot." No symptoms; foot perfect.

DIAGNOSIS. The existence of flat-foot can be demonstrated by having the patient step with the wet sole upon the floor or upon a piece of paper, or more accurately, by having the patient with the bare foot step upon a piece of cardboard blackened with camphor-smoke. In either case the imprint will show whether the arch is normal or whether it is abnormally high or low. In the former case it is contracted foot, and in the latter case flat-foot. If dorsal flexion of the foot is limited at a right angle, contracted foot is present. The presence or absence of flat-foot proper depends entirely upon the study of the imprint tracing. The existence of pronated foot must for the present be detected by the eye, by noticing

whether in standing the line of the leg passes, as it should, through the second toe, or inner side of the first toe, when weight is borne upon the foot. It may be noted in passing that in one hundred

FIG. 13.

Pronated foot without breaking down of the arch (see tracing).

FIG. 14.

Flat-foot—painful—showing similarity of position to Fig. 13.

tracings of nurses studied, the condition of contracted foot, as demonstrated by the tracing, existed in one nurse in ten, and that a tracing perfectly characteristic of flat-foot existed in the same proportion of cases, one in ten, yet in no one of these apparently abnormal tracings was pain or disability present. (Figs. 13 and 14.)

TREATMENT. Pronated foot and mild flat-foot differ but little in treatment, except that in the former support to the arch of the foot is not always necessary. Remedial measures will be considered in order, beginning with the mildest :

Boots. Proper boots should be insisted upon. The essentials of a good boot are the following :

1. A straight or nearly straight inside edge. (Fig. 15.)

FIG. 15.

Boot of improved pattern (the inner edge is not quite so straight as it should be theoretically).

2. The sole of the boot should be as wide as the sole of the foot when weight is borne upon it, across the front of the foot opposite the metatarso-phalangeal joint.

3. The shank should not be cut away at the inside, but should be moderately high and should support the arch of the foot.

4. The forward part of the foot should be at an angle to the back part, so that the foot should be held in a position of adduction. In short, the sole of the boot should be constructed upon a curve, with

the convexity outward. Pronation, it has been seen, is necessarily associated with abduction. Anything which tends to diminish abduction tends to prevent pronation. Consequently the boot which holds the foot in the adducted position is most likely to prevent the occurrence of pronation.

Practically the same points are essential in the boots for children.

Raising the inside of the sole. In cases with troublesome pronation, but with no breaking down of the arch of the foot, it is desirable to raise the inner side of the sole and heel of the boot one-eighth or one-quarter of an inch, or more if necessary. This is done by making the inner side of the sole and heel thicker than the outer side. This throws the foot more toward its outer side and changes the bearing of the foot. This may be done whether or not plates or pads are used.

Supports. If the arch is broken down, or if raising the inner side of the boot until the correct position of standing is induced is not sufficient, a brace may be applied with a pad over the internal malleolus, which shall press the foot over on to its inner side. A pad or a plate may be applied to hold up the arch of the foot, and by supporting the weight in that way to throw the foot on to its inner side.

In the hands of the writers the use of a simple silicon bronze plate, accurately shaped to fit the arch of the foot, has produced the

Fig. 16.

Flat-foot plate, right foot.

best results. The limits of this plate are shown in the photograph (Fig. 16). The use of pads of felt and leather, of elastic springs, and of other devices has not, as a rule, been as satisfactory in the hands of the writers as that of a metal rigid plate. Pads of leather or felt tend to break down the shank of the shoe, and in time to make it convex downward. It is, to our mind, of the greatest importance that the plate should fit accurately, and, if possible, patients should be fitted by the workmen where the plate can be

bent hot. This measure has been adopted by the writers, because it was found that sore points in the sole of the foot were not reproduced if the plate was fitted to a plaster cast, and that the comfortable fitting of the plate was a matter of precision only to be obtained in this way. The writers would wish to insist most strongly on this accurate adjustment of the plate.

Plates are not applied with the view of furnishing a permanent support. They are put in, on the contrary, in most cases, with the idea that they shall be removed as soon as the foot shall have been restored to its normal condition. In certain cases there seems to be what one would call a reflex irritation in these feet which leads to a breaking down of the arch. That is to say, if these feet are soothed by plates or pads, or by rest, the arch is to a certain extent restored temporarily, and it is a common experience in the use of accurately fitting plates that after a month or so a patient becomes uncomfortable, and it is found by inspecting the marking on the plate that the arch has raised and that the plate fails to support it, and the plate must be arched still more in order to be a support. The writers can recall three recent patients, one a woman weighing 190 pounds, and the mother of four children, who have been able to go without plates after wearing them from six to ten months. This the writers do not attribute entirely to the use of plates, but also to the general treatment.

With regard to the general and local treatment other than the use of proper boots and plates, the writers would wish to lay great stress upon the value of massage and exercises for restoring the use of the muscles at fault. In pronated foot and flat-foot it is common for the circulation to be poor, the veins to be enlarged, the feet to sweat profusely, and the general circulation of the feet to be in a very unsatisfactory condition. It is obvious under these circumstances that massage and manipulation are strongly indicated, and in cases where these are not obtainable that exercise should be prescribed which would call into action those muscles which support the arch of the foot and tend to produce an adducted position. Forcible adduction of the forward part of the foot against resistance, rising on tip-toe, and similar exercises are types of the requirements in this respect.

With regard to the treatment of contracted foot, certain cases,

especially if acute, are relieved by placing a pad of felt or a metal plate under the abnormally high arch. Other cases are not quieted by this measure and require stretching of the gastrocnemius muscle by Dr. Shaffer's shoe, a remedy which is also useful in certain cases of flat-foot and pronated foot associated with limitation of dorsal flexion. Patients with contracted foot, as a rule, find comfort in wearing boots with moderately high heels.

It is difficult to present a summary of a paper which at best is only a brief mention of many points. What the writers would particularly wish to call to your attention are the following points :

There are three well-marked conditions which give rise to much the same symptoms, and which are associated with some abnormality of the foot. These are pronated foot, flat-foot, and contracted foot. Pronated foot and flat-foot are most often favored by bad boots, which render the feet vulnerable and improperly supported.

The etiological relations of contracted foot are entirely obscure.

The treatment of these three conditions consists in the use of boots which shall allow the foot to be placed upon the ground in its proper relation and which shall favor a correct position of standing.

If the arch is broken down some appliance should be used to support it, so that the foot may rest in a proper position.

These appliances are used merely as temporary measures and should be applied only in connection with exercises and manipulation intended to restore the muscles to their normal function.

METATARSALGIA.

By L. A. WEIGEL, M.D.,
ROCHESTER, N. Y.

I HAVE not prepared a formal paper on metatarsalgia, and will confine myself to a few remarks on this subject, to supplement some of the points brought out by the previous speakers. Pain referred to the anterior part of the foot, the so-called anterior metatarsalgia, is usually ascribed to a pinching of the nerve between the fourth and fifth metatarsal bones, or to a breaking down of the transverse arch of the foot; in other words, that the cause of the discomfort is a mechanical one. While this may be true in a certain proportion of cases, we must not lose sight of the fact that pain in this region is not infrequently due to causes that are not mechanical, and hence are not amenable to mechanical treatment. In my experience metatarsalgia is frequently met with in anæmic and neurotic subjects, in whom the local pain is but an expression of an impaired constitutional condition. I believe that failure to appreciate this fact explains the unsatisfactory results from a treatment that is largely mechanical in its nature. Massage, exercises, etc., no doubt exert a favorable influence upon nutrition and promote recovery when the affection can be traced to local causes. But they will be of little use in the class of cases referred to unless a systematic course of treatment directed toward improving the constitutional condition of the patient be used at the same time. Local treatment is often advisable for the temporary relief of pain, and for this purpose the application of the galvanic current has given me the best results.

When it is determined that mechanical support is necessary, some sort of an appliance that is definite in its action should be used. Bandages, soft felt pads, etc., seem to me undesirable and inefficient. Bandages applied sufficiently firm to prevent spreading of the foot

are usually uncomfortable, and often increase the pain. A metal plate of some kind is really the only efficient mechanical appliance for supporting the foot. I am in the habit of using a plate made according to the method described by me at a previous meeting. The material is a phosphor-bronze composition; it is not a hammered plate, but is cast in a mould. The pattern for the moulder is made of crinoline and plaster-of-Paris upon a corrected cast of the foot. Three or four pieces of crinoline saturated with plaster cream are smoothly applied to the cast in successive layers and allowed to set. When dry the pattern is removed from the cast and trimmed to the desired size and shape, and is then reproduced in the metal casting. The plate I show you was made in this manner. The special advantage of this metal is that it does not rust or corrode, and is sufficiently malleable to allow modifications to be made with a ball-peen hammer. The method of making the pattern as described secures such a perfect fit that very few, if any, alterations are required in the finished plate. In a hammered steel plate it is rather difficult to get a sufficient degree of anterior convexity to raise and support the transverse arch of the foot properly. This difficulty is obviated in the cast plate, as you will see by the cast and pattern I show you.

The extent to which a metal plate should be arched and how far forward it should extend must be governed by the requirements of the individual case. I have found in several instances that when the plate extended to the heads of the metatarsal bones, as is usually recommended, the transverse arch of the foot was not properly supported, and relief was not obtained. In these cases I make the plate long enough to support the heads of the metatarsal bones themselves. The anterior edge of a short plate is apt to crowd itself behind the heads of the bones and make uncomfortable pressure, while a longer plate gives better support and is more agreeable to the patient.

In making a cast of a foot, it is essential not only to reproduce all bony prominences, but also to exaggerate them somewhat afterward in modelling it. In this way painful pressure of the plate, to which Dr. Lovett referred, is avoided.

DISCUSSION.

Dr. L. A. Weigel. Since we are on the subject of flat-foot, I have a little cast here which I think will be of special interest to the members of the Association. The cast was given to me by Professor Ward, Professor of Natural Science, and was taken from an actual subject in China. It is a typical Chinese foot, showing the distortion produced as the result of fashion.

Dr. Reginald H. Sayre. The subject of flat-foot has been ably presented this afternoon. I think the cast Dr. Weigel has passed around ought to teach us that, if by persistence and the use of mild measures a man can make a normal foot look like that, with the same amount of persistence and the same care he can make an abnormal foot into a very respectable, useful member.

Dr. Lovett and Dr. Whitman have laid a good deal of stress upon distortion of children's feet by badly fitting shoes. It seems to me there is another element which enters into distortion of the foot almost as much, and that is badly fitting stockings. I think you will find that a great many stockings are so constructed, with remarkably narrow-pointed toes, that if you have made a shoe with a straight inner border the foot is unable to occupy that position on account of the constriction of the toes by the stocking. A firm has been making what we call walkenfast stockings, with rights and lefts to the stockings as well as to the shoes.

Another point that struck me in looking at these tracings as they were passed around is something which I have practical experience with in the case of certain shoes I have had myself, and that is, the outer border of the shoe was not sufficiently wide to admit free play of the small toes. In all of these tracings I notice there is sufficient room for the big toe and the inner border of the foot. The outer border of the shoe does not extend, in certain instances, as far as the small toes in the tracings. An uncomfortable callus may be reproduced on the top of the toe, causing it to be corroded, something after the manner of the Chinese foot you saw. The shoemaker has a tendency, when he inverts the inner edge of a shoe, to invert the outer edge as well, pressing toward the little toes.

Dr. V. P. Gibney. I will discuss one or two points in connection with these papers, and first with reference to flat-foot or pronation. It so happened that during the past year I had the heads of three training schools under my care for this condition of the feet, and in every instance they were wearing the Kahler shoes, and it was said they instructed all nurses to get these shoes. I saw several cases among the nurses. In two of the training schools there is an epidemic of incipient flat-foot. Correction has been attempted. Dr. Whitman and Dr. Lovett have suggested to fit them with properly shaped boots and to prescribe moderate exercise and alter the style of the shoes they are wearing. I think these are good points.

With regard to metatarsalgia, I do not quite see the necessity of a plate such as Dr. Weigel has presented, unless it is to be worn in extreme cases. In the greater number of cases of metatarsalgia I do not employ a spint; I relieve them by building the boot on a high last—a Spanish last—inclining it toward the outer side and giving uniform pressure in the skank of the foot or to the arch by making it fit snugly across the instep, by having a low heel and carrying it well forward. The weight will be less on the heel. These boots may be wide at the toe and straight on the inner side. Out of a large number of cases which I have had during the last four or five years I have encountered very few failures, probably four or five altogether. The ladies who suffered got rather tired of having shoes made to order and paying $10 or $12 for them. They abandoned the shoes because they were rather expensive, and did not care to consult a doctor about the matter. They finally got into a row with their shoemaker, as a result of which they changed shoemakers and have gone back to the other shoes. They could not get the relief they desired. A number of cases have come under my care a second or third time, and in every instance but little attention was given in the way of instruction for the patients to get the desired relief. Some of them suffered relapses, only on failnre to wear the style of boot prescribed. It is not an ungainly boot by any means. I believe that we should have constructed a good, substantial sole. I do not think that a paper sole gives proper support. The main point I insist upon

is uniform support from the ball of the foot, having the ball free from any pressure.

The Chinese foot which the doctor has presented differs a little from the foot I had the opportunity of seeing a year and a half ago. A Chinese lady wanted American feet made for her, her idea being to have artificial feet, and then she could leave the fancy feet which she brought from China, and get about like American ladies do on the street. She found it very difficult in Washington and New York City to get about. In the first place, it was a case of extreme cavus. The os calcis, which was tilted downward, was vertical, and this deep sulcus which you see extended up to the malleolus. In this sulcus there was eczema. The metatarsal bones were on a line parallel to the os calcis, and the bones extending from the phalanges were much elongated, and she stepped practically on the tips of her first metatarsal bone and on the back part of the extreme end of the os calcis. That made a very nice looking foot indeed, with a long toe, and seemed quite presentable, but totally unfit for use. That kind of foot I have not seen among the every-day Chinese, and I must confess that my observation is limited to only one case.

Dr. Roswell Park. The papers to which we have listened are the most valuable of any which have thus far come before the Association, or at least since I have been present. Dr. Lovett has solved the problem for us concerning the etiology of the flat-foot, and he has presented it in a much more satisfactory way than it has been done heretofore. I do not rise to discuss the papers so much as to suggest simply that if in a certain proportion of cases the shortening of the gastrocnemius muscle is the particular cause of this trouble, would it not be a sensible and quick way to divide the tendo-Achillis in connection with the rest of the treatment?

I want to criticise two terms that were used, and one was in reference to the matter of non-deforming club-foot. It seems to me a contradiction, and it is as foolish a misapplication of the term as it would be to say "invisible lordosis." The other term is that of metatarsalgia. While I like the term, I do not like to have it applied to two different conditions. It has been applied to the disease sometimes known as Morton's painful affection of the foot.

If it be used for that, it should not be used for this. This Association might be able to decide as to how to apply these terms. I certainly think metatarsalgia should not cover two conditions.

Dr. Joel E. Goldthwait. There seems to be some misunderstanding in regard to the term metatarsalgia, which is confused with the condition described as Morton's painful affection of the foot. Both seem to me to be the same condition, and in most cases to be due to a flattening of the anterior arch of the foot. These cases have been relieved by throwing up the front of the foot, giving some support in the middle of it, then holding the foot snugly together behind the metatarsal joints. I should take exception in my experience to what Dr. Weigel says about the rigid support, and in almost all of the cases I have been able to accomplish the desired object by applying a felt pad, made into a leather inner sole.

A Member. How far forward?

Dr. Goldthwait. Just back of or near the head of the metatarsal bones, the pressure going back to the middle of the foot. The condition is almost always seen in connection with some weakness of the longitudinal arch.

In connection with the treatment, like bandaging or pads, I think exercise is of the first importance, and in the line suggested by Dr. Whitman. The contracted muscles which are going to hold and do the work for the longitudinal arch, as well as in the front part of the foot, should be stimulated by massage, with walking and proper shoes. The relief the patient gets is remarkable in some cases.

I have a few tracings here which may be of some interest. The longitudinal arch is pretty well preserved; there is no giving way, and very little pronation or abduction of the foot. This you see is a good-shaped foot. This foot here has by actual measurement a bearing surface one-half inch broader than this one.

Dr. George W. Ryan. I desire to express my interest in the papers to which we have listened this afternoon, and will speak of

one anatomical point referred to by Dr. Lovett, that flat-foot is congenital with children. This is a general and widespread idea, and I believe it is taught by a great many physicians.

Concerning the treatment of flat-foot, I have always maintained, in spite of opposition in my section of the country, that milder methods of treatment offered far better results. In common with the last speaker, a steel spring with one free end to it is giving exceedingly satisfactory results. It is based on a better principle than a rigid support such as has been so generally used in the last few years. It permits of freedom of muscular action to the foot. It keeps up in a measure exercise which most of us have found very comfortable.

Regarding metatarsalgia, which has been spoken of as Morton's painful disease of the foot, I find that in many cases by strapping the feet with adhesive plaster I secure a great deal of relief. I have had a few cases of absolute cure if the treatment was kept up for a period of some months.

Dr. Arthur J. Gillette. With reference to shortening of the tendo-Achillis, I have observed in the cases I have seen of marked flat-foot a correspondingly marked contraction of the tendo-Achillis according to the amount of flattening. I find you cannot get a foot up to the normal angle referred to here to-day; and the relaxed tendo-Achillis from paralysis causes an opposite position. I have examined every case that came to me of late, and found that condition.

In regard to the etherization of the patient to overcome these marked conditions and reduce the dislocation, I have not found it always necessary to give an anæsthetic. I find that with repeated dressings with plaster I can correct the position as much as possible; in other words, immobilization and rest will relieve the muscular spasm, and at the second or third dressing you can put it into place. I have had two cases, one a servant-girl who could not stop working, and refused to go to a hospital. I applied a cast, got her to walk, and she did her housework. At the second dressing the spasm of the muscles was disappearing, and when we applied the fourth dressing the foot was in good shape. In another case, a school-teacher, in the midst of her school-work, and could

not leave it, I succeeded in doing the same thing for her, she wearing the plasters in attending to her school duties.

Dr. A. M. Phelps. With reference to shortening of the gastrocnemius muscle as being a cause of flat-foot, I hardly believe that idea is correct. Why do we train our patients to rise upon their toes long enough to shorten the gastrocnemius and produce arching of the foot? As a matter of fact, the gastrocnemius becomes shortened after this manner, that if a man rises on his toes and shortens the gastrocnemius he shortens his foot. As the arch breaks down it slackens this muscle, and if you allow certain slack of any muscle it becomes contracted, and after a time contractured. Shortening of the gastrocnemius is the result, not the cause, of flat-foot.

As regards the stretching of this muscle when it is shortened, consuming months of valuable time to do it, I believe it is much better to cut the fibrous tissue. I think the tendo-Achillis should be divided with a tenotome, and thus save weeks and months of valuable time. If the operation is done correctly, union of the tendon will always take place.

As regards the use of machines for stretching, it seems to me that we can accomplish the same thing with our hands, and that costs nothing.

With reference to measurements with a machine, I do not think we have any machine that is better than the naked eye. You can do with it what you can do with a machine. I have learned to do with my eye and my hands in this class of work what is done by machines, used as substitutes. In the treatment of flat-foot I believe the mechanical treatment should be supplemented by division of such tissues as are so contracted as to resist force. Where there is much pain in these cases the Paquelin cautery will be found to relieve it.

In conclusion, I want to say that when the three papers to which we have listened this afternoon are published in the Transactions we shall be able to point to them with pride.

Dr. R. W. Lovett. I want to say a word in regard to the arched sole. There are two boots in two styles, one with the

ordinary sole, as you see here, and one with the Spanish last, hollowed out. Some members evidently thought that I stated in my paper that habitual flat-foot did not occur in children. Such is not, of course, the case.

Dr. Louis A. Weigel. The objection to the term metatarsalgia is not well founded. We use the term, practically, to describe a condition, in which metatarsalgia—*i. e.*, pain in the metatarsus, is the prominent symptom, and which may be produced by various causes. It does not commit us to any special pathological condition any more than the use of the term jaundice does. The objection to rigid plates is more apparent than real. The speaker states that he uses a felt pad, put under a leather sole, so as to make it quite rigid. I accomplish the same thing with a metal plate. So it is simply a question of degree, and not of kind of support. One may be a little more rigid than the other.

The question of flat-foot springs has been discussed for years, figured in our text-books, and abandoned for good reasons.

Dr. Royal Whitman. I was surprised to hear the reader state that he did not know why the stretching of a shortened tendo-Achillis was of benefit in the treatment of flat-foot. If he would simply change his point of view and look on the foot as a human machine, it must at once be evident that permanent limitation of an essential motion must be removed before a cure could be obtained. As to this restriction of dorsal flexion, the question was not as to its occasional presence, but it was whether this shortening of the calf-muscle was the primary and essential cause of flat-foot, or simply an accompaniment like the other accommodative changes to be found in deformity. He would again assert that no evidence had been produced to support the former claim. If, however, such contraction existed, it must be overcome, either by the mechanical or manipulative stretching mentioned by the reader, or by tenotomy, an operation which he had often performed in the treatment of the adult type of flat-foot.

ON THE DEFORMITIES AND MALFORMATIONS RESULTING FROM ACUTE INFECTIONS IN BONE.

By ROSWELL PARK, M.D.,
BUFFALO, N. Y.

It is apparently the depth and the concealed location of the bone-marrow which have prevented a more general and widespread recognition of the readiness with which the internal structure of bone succumbs to infection and destruction. The clinical consequences of this internal disease have long been recognized, but accurate notions regarding its pathology have not been in vogue until comparatively quite recently. At the very outset it is well to make an abrupt distinction between those alterations in texture, contour, density, etc., of bone which are the result of perverted nutrition, of alterations of trophic nerve-influence, etc., and which are distinctly not infectious, and another series of changes similar, perhaps, in gross results, very dissimilar in etiology, which are the consequences of acute infectious processes, which have their analogies in various of the soft structures of the body, where they have been longer recognized and more carefully studied, because more easy of access. Indeed, as Savory some years ago showed, bone and lung react in a very similar way to infections, the analogy in some respects being even striking. Both bone and lung are surrounded by a firm, investing membrane; both have a more or less spongy texture; both are extremely liable to tubercular invasion, while in either case the disease usually selects the apices for its primary manifestation; both are in close relation (the bones especially by their joint ends), with serous cavities, which become secondarily involved in the majority of instances: in the one case, as a pleuritic effusion or an empyema; in the other case, as a joint-effusion or a pyarthrosis; while the picture

of miliary tubercle in either structure is beautifully distinct and clear. Savory did not point out, however, that which I would like to emphasize here, for instance, that bone as a tissue is, nevertheless, subject to an acute miliary invasion of tubercle corresponding to an acute miliary tuberculosis, as well as to certain streptococcus and staphylococcus invasion, producing a condition of affairs corresponding essentially to acute lobar pneumonia, in which the whole structure of an epiphysis or a shaft is involved, and in which, owing to the intensity of the process, local gangrene may result, producing in the one case a gangrene of the lung, in the other a gangrene of the bone—a fulminatingly acute necrosis which means death of the patient if not speedily attended to.

We need not hesitate, then, to compare bone and lung, if only we take the view concerning the former that students are not generally enough taught that the calcareous infiltration of bone is simply an incident favoring its physiological function, and that it may become inflamed and act in every other way like any of the soft tissues. When we cease to make artificial distinctions, which nature does not make, we shall have much clearer ideas of bone pathology. The acute phases of these infectious processes are not usually considered in works on orthopedic surgery, nor do they often come under the observation of orthopedists, who are so often concerned with their remote consequences. Nevertheless, in order that the matter may be the better appreciated, I deem it wise to say a little more about the acute condition first. That acute inflammation (*i. e.*, infection) of all or any of the structures which go to make up the bone is possible is a well-established fact. Inasmuch as each one of these tissues comes at least into close contact and relation with the others, even if it does not insensibly merge into it, it is not often that one meets with an infection of one which is not conveyed to the others. Clinically, however, there are three locations in which these manifestations are most commonly met with :

1. Beneath the periosteum.
2. In the epiphyses.
3. In the diaphyses.

From the pathological side infections are of four main varieties :

1. The tubercular.
2. The staphylococcus.

3. The streptococcus.
4. The pneumococcus.

To these may be added:

5. Rare instances in which other organisms are primarily or secondarily present.

Of these certainly the more common is the tubercular form, whose manifestations, however, are usually not acute. The other three may be grouped in a general way as pyogenic forms of invasion in which pus is practically invariably produced, provided only that sufficient time has elapsed.

Although it is not exactly germane to my subject, I cannot let this opportunity pass without calling special attention to one manifestation of tubercular bone-disease, which I grant is rare, but, nevertheless, which is not sufficiently recognized. I allude to the acute miliary tuberculosis of bone which corresponds in most essentials with similar invasions of the lungs, and of which I have seen occasional examples. This is not generally described, even in the most recent literature, and would deserve more space than I can give it here were this the place in which to consider it. It is not quite so rapid as the pyogenic forms; and it may take two or three weeks to produce such destruction of the bone as to necessitate operation. It stands, therefore, in intermediate position between the acute infections and the slower (*i. e.*, usually the tubercular) lesions. Nevertheless, it is sufficiently acute to demand prompt recognition, and when recognized may often be relieved by prompt operative interference.

The course of a bone-disease, then, will depend first upon the location of the lesion, and secondly upon its character. If it assume a very acute type, and if prompt evacuation of morbid products be carried out, such a bone-disturbance will usually subside with very little deformity, there remaining, perhaps, only a scar marking the site of the operation. Take, for instance, a subperiosteal infection of the ulna or fibula. If, now, this be recognized during the first day or two, and if a long incision be made down on the bone, there is ample opportunity for escape of pus and of other morbid products, and there will be prompt reapplication and reunion of periosteum and bone with a minimum of loss of function, occasioned only by the occurrence of a cicatrix. If a deep and acute bone-abscess form in

the shaft of a bone, and the same be promptly opened, it corresponds to an acute abscess in the neck or elsewhere, and only a scar will remain to indicate what has happened. If, however, prompt recognition and immediate incision do not occur, the consequence will be extension of the disease, increasing destruction of bone, possibly necrosis of the entire bone-shaft between epiphyseal junctions, possibly spontaneous perforation, with sinuses through which sequestra may protrude or at least be recognized. These usually come to the surface by a reasonably direct route, which affords exit with a minimum of disturbance of surrounding soft parts; but this is by no means always the case.

Finally, if the acute focus be located in an epiphysis, there is usually prompt involvement and infection of the joint, loosening of epiphyseal connection, with a resultant pyarthrosis and necrosis of a bone-end, which will require something more than a mere opening and evacuation of a joint, which may call for resection or even amputation. In such a case dislocation finally occurs. I have seen this condition most often at the hip, and have known of an acute osteomyelitis of the upper epiphysis of the femur which pursued a rapid and unbroken course until such destruction occurred as to permit of spontaneous luxation during the act of lifting the patient, with the production of two inches of shortening within half an hour. Such a case is an aggravated one, to be sure, not illustrating the common phases of this disease, yet, nevertheless, not so rare as could be wished, and not one whit overdrawn. I have, moreover, repeatedly seen such absorption of calcareous stiffening—in other words, such an artificial and pathological flexibility of bone produced—that torsion of the shaft of long bones or more or less angular deformity was produced, either rapidly, in some instances by mere muscle-spasm, or in other cases by too early or indiscreet effort to support the weight of the body.

Osteomyelitis may be a tedious and long-drawn-out disease, which may also be characterized by acute exacerbations. It is well to keep this fact in mind, for it does not follow that every bone fistula or sinus is due to tubercular disease, though it is always open to the presumption of having become tubercularly infected. Albert, for instance, has called attention to the confusion between the two conditions, especially in the latter part of certain cases. The anatom-

ical picture about the joint involved in the one case is not materially different from that of the other.

Concerning the character and extent of possible destruction in these cases, one meets with all degrees of destructive changes, from the mildest appreciable up to total destruction of an entire bone, or even to gangrene of an entire extremity. Other things being equal, the most destructive lesions are those which produce the greatest deformity. Yet, of the inveterately deformed cases, it is sometimes those which are least involved which will be subjected to orthopedic treatment, while those in which deformity is very great would be subjected to resection or amputation.

If one seek for the reason why one bone is involved oftener than another, it may possibly be explained by the normal rapidity of bone-growth in different bones. According to the investigations of Langer, the coefficient of growth in the femur is 4.38; in the tibia 4.32; in the humerus 3.97; in the radius 3.83. This scale perfectly coincides with the frequency of disease in the bones mentioned. Studying for a moment the prevailing localities in which remains of lesions are found, and basing this study upon 181 patients collected by Helferich, we find that the lower end of the femur was involved in forty instances, the upper end of the tibia in twenty-nine, the tibial shaft in nineteen, the lower end of the tibia in eighteen, the upper end of the humerus in sixteen, the remainder being scattering. These, to be sure, were cases of necrosis as the result of the disease; and, nevertheless, they serve our purpose in showing relative frequency of location of foci.

As showing also the relative frequency of parts involved, of thirty cases observed by Kocher the disease occurred thirteen times in the tibia and eleven in the femur. Of ninety-eight cases collected by Leucke and Volkmann, the femur was involved thirty-six times, the tibia thirty-four, and the humerus eleven. Disease in the immediate neighborhood of the hip-joint is about five times as common as in that of the knee. Comparing epiphyses with diaphyses, and accepting Schede's sixty-seven cases, we find that of twenty-eight cases in which the femur was involved, half of them were in the shaft and half in the diaphysis. In the tibia, of twenty-seven cases only nine concerned the epiphysis; and of seven cases of the humerus, two involved the epiphysis.

Arrests of development in bone as due to bone-inflammations have long been known. Blasius, for instance, described a case in which an adult arm never passed beyond the dimensions of that of a child; and numerous such cases are on record. Mild differences of this kind have been often overlooked, as Helferich emphasizes. As between the two femora and the two humeri considerable changes may often be noted, which will be explained if one gets a careful history of the patient's life. I may also remind this Association of that form of increase in the length of long bones spoken of by Ollier and Mondan as "atrophic elongation," to which I called attention a few years ago in a paper to which I would refer those who are further interested.

Relative to persistent joint-lesions which may result from acute bone-infections, we may get very interesting statistics from the memoir of Haaga. Out of twenty-eight cases in which the upper end of the femur was involved, in twenty-two there were more or less well-marked persistent lesions. Of these twenty-two, in fourteen mobility was diminished; and in ten of these there was absolute anchylosis, twice in the straight line, eight times with more or less flexion of the thigh. In the other eight cases there was spontaneous luxation to a greater or less extent. Out of twenty-eight cases involving the arms, the humerus was involved seven times; and of these seven cases one presented a subcoracoid luxation, and in another a very marked limitation of movement existed. In two others there was a persistent hydrarthrosis. Of nineteen cases involving the elbow, the humerus was involved in ten, the radius in six, the ulna in three; the elbow-joint was destroyed in two of them, was anchylosed in four, and presented distinct lesions in all the others. Of these nineteen cases the immediate neighborhood of the joint was involved in only seven; in the other twelve the lesion was more or less remote from the joint. In seven cases involving the wrist, the radius was involved in four, the ulna in three; in each instance anchylosis was complete, and in four others there was marked restriction of motion.

Haaga has epitomized 470 cases of distinct osseous foci altogether, in which 189 showed distinct joint-lesions, which were more or less persistent.

Out of twenty-four cases involving the ankle, the lower extremity

of the fibula was involved in but one. Of these, twenty-one were more or less anchylosed; in one case there was a flail-joint; in two instances the joint was destroyed; and in one there was chronic hydrarthrosis.

Secondary affections of the knee were extremely frequent. Of 107 cases of disease of the lower end of the femur, the knee was involved in seventy-one. Of fifty-four cases of involvement of the upper end of the tibia, the knee was involved in twenty-one. Studying 109 lesions of the knee, Haaga found luxation forward once, subluxation nine times, flail-joint eleven times, articular destruction five times, late suppuration six times, while motility was diminished in seventy-seven cases, of which in twenty the difficulty was caused by anchylosis and in fifty-seven by a contracture.

Another kind of deformity is that produced by arrest of growth of the joint-end of one bone and compensatory hypertrophy or parallel alterations in the other and participating bone. Absolute arrest of development occurs naturally only in growing children or adolescents; and these deformities will at least arise during youth, although they may be not met with much later. I have, for instance, in my possession a specimen illustrating arrest of growth of the lower end of the tibia, while the fibula continued to grow, so that its lower end assumed a literally circular shape, the lower two and a half inches constituting 90° of a circle of four or five inches in radius. In a case, for instance, reported by Marchant (*Revue d'Orthopedie*, March, 1895), the region of the knee was greatly enlarged and deformed by the presence, on the inner side and posteriorly, of the head of the fibula, whose upper styloid process was on a line with the upper border of the patella, having been pressed there by the weight of the body and lack of growth in the tibia. The upper half of the fibula was greatly thickened, but flexion was possible to a right angle.

One should also speak in this connection of that class of deformities which are produced by muscle-contractures, which have at the time when seen not yet proceeded to the point of anchylosis, except so far that motion beyond certain degrees was impossible because of these same contractures. In other words, these are joints whose function is much interfered with, and in which extremes of motion are not permitted, and which, nevertheless, serve still a useful pur-

pose in most respects. I do not know that there is any marked difference in the frequency with which the various joints present lesions of this kind. In more or less mild degree and for greater or less length of time, these conditions obtain in the neighborhood of any joint which lies in proximity to a focus of acute bone-infection.

Torsion and flexion of bone which has been the seat of previous disease are not at all infrequent. Even muscle-pull alone is sufficient to account for many of these cases. Richter has reported, from the Breslau Clinic, a specimen of diseased bone in which fracture had been diagnosed because of the deformity. Diesterweg has also described a similar case from Volkmann's clinic, in which there was such remarkable curvature of the trochanteric part of the femur as to permit of luxation. (*Ueber die Verbiegungen der Diaphyses nach Osteomyelitis Acuta*, Diss., Halle, 1882.)

In a general way, I would divide the deformities which are due to inflammatory bone-changes into those which pertain to juxta-articular lesions and those which have their anatomical seat in the shafts of the long bones. This is a classification purely for purposes of convenience, and implies nothing regarding pathological differences. Of the former class, the most conspicuous are, first, those produced by *anchylosis*. This will be readily appreciated as due to the intensity of inflammatory change and to organization of solid exudate, to cicatricial contraction, etc. It is usually of the spurious or fibrous type, but is occasionally of true osseous character. I could show, were it desirable, numerous specimens indicating the rigid consolidation and stiffening of such joints by osseous tissue.

There is a variety of change, of which frequent expressions are seen, which is due to compensatory enlargement of one bone in order to atone for more or less weakness of another. This, of course, is met with only in the leg and forearm, where we have paired bones. I have seen several instances where, after serious weakening of the tibia, the fibula has enlarged almost to the previous size of the tibia, and has gradually prepared itself in this way for sustaining the weight of the body and assuming new functions. Along with these changes in the bone-shaft there are also changes at the extremities, which would be difficult to describe in a few words, and which hardly call for it, the present paper being concerned rather with statement of facts than with minute description of cases. One may see the

same condition in milder degree in the metacarpal and metatarsal bones. I am not aware of similar changes having been noted in the ribs, although I consider them possible.

Dislocations and subluxations constitute another variety of joint-deformities which may have been produced either by muscle-spasm alone, as in the slower forms of tubercular disease; by destruction of the ligaments and removal of opposition to displacement; or by epiphyseal separations, which sometimes occur in connection with acute cases of the pyogenic type.

The dislocations met with as the consequence of bone-infections may be described, first, as of the distention-form, that is, they are permitted through the great distention of the joint as the result of outpour of products of inflammation and infection. These are the most genuine of the spontaneous luxations. A remarkable case of this kind was observed at the shoulder by Stromeyer.

A second form is due to the early consolidation between epiphysis and diaphysis, and the consequent cessation of growth at this point. When, for instance, this occurs in the tibia, the corresponding fibula-end will continue to grow, and subluxation must be the result. I have now under occasional observation a young lad whose radius was nearly destroyed by an acute infection of this character, but whose ulna has continued to grow. The styloid process of his ulna now presents nearly half-way down on the outside of the fifth metacarpal, and great displacement and deformity of the hand result. In this case I have advised and expect to perform a resection very soon.

A third case of osteomyelitic dislocation is due to overgrowth of the ligaments, *i. e.*, due to hyperæmia of the parts and increase of nutriment conveyed toward the seat of activity. Ligamentous bands thus overgrown stretch and give rise to flail-like conditions of the joints.

Albert has also alluded to the spontaneous fracture due to epiphyseal separation. In most of these cases the epiphyseal cartilage will be found normal, and it is rather in and about the shaft of the bone that one would look for most evidence of disease.

Epiphyseal separations, accurately speaking, are among the most serious of complications. According to observations made by Garré, in Tübingen, they occur in from 12 to 15 per cent. of cases These

occur most frequently of all at the lower end of the femur, then at the upper extremity of the tibia, and then at the hip.

Epiphyseal separation without suppuration is rare, but has been distinctly established. Until further investigations clear up its pathology, we must hold it to be due to such alterations in nutritive supply and vascular conditions of the involved bone that there are solution and disappearance of those calcium salts which are usually regarded as cementing, by their deposition, the union of epiphysis to shaft.

Ullmann reports a patient, twelve years of age, with 8 cm. shortening of the thigh with angular deformity. Here it was very evident that spontaneous fracture had taken place at the site of an old bone-focus. Fracture may also occur as the result of rarefying ostitis without the necessary presence of a sequestrum. Spontaneous fractures also occur sometimes after operations made necessary for removal of large sequestra; and I have myself twice seen the tibia break in this way. Such cases constitute in effect a sort of infected compound fracture, and it is not to be expected that recovery will ensue without considerable shortening, distortion or other changes.

Some special manifestations of osteomyelitis are met with in somewhat novel and unusual places. Thus, Froehner has published a unique case of infectious osteomyelitis of the nasal bones. It occurred in a young man of seventeen years, and was followed by fever with tumefaction of the region involved. The jaws are known to be occasionally involved as well, and perhaps most often in those instances of multiple lesions which are of pathological rather than of orthopedic interest. In one instance, mentioned by Gangolphe, the jaw was involved along with both tibiæ, a metatarsal bone, and the sacrum. This form of esteomyelitis of the jaw is to be distinguished from the post-febrile form of periostitis, to which Salter has particularly called attention as following measles, scarlatina, etc. While the latter is distinctly a secondary infection, it, nevertheless, has an etiology somewhat different from that met with, for instance, in Gangolphe's case.

Osteomyelitis of the skull is usually followed by acute necrosis, and will frequently terminate within a short time by meningitis, sinus phlebitis, pneumonia, endocarditis, or other pyæmic manifesta-

tions; it has for us, as orthopedists, only a remote interest at this time.

But osteomyelitis of the vertebral column, although rare, may concern us very deeply. Such a case has been reported, for instance, by Lannelongue as one of primary infection of the vertebral column with metastatic lesions in the leg and in the forearm. The result in his case was death; but the fact that these lesions may occur in this location should by no means be forgotten.

So, too, in the clavicle, osteomyelitis is usually followed by acute and total necrosis. In some instances there has been a very tardy reproduction of bone, due to activity of the osteoblasts which remained upon the periosteum. Such disease in this bone may give rise to great disfigurement about the shoulder, as well as loss or disturbance of function. So, also, in the ribs and in the sternum. One meets in literature with isolated cases which are not without considerable interest. Thus, Froehner observed a case of this kind in a young child of four years, in which suppuration occurred and necrosis followed. Considerable attention has been paid to this matter in two or three recent French theses, as by Berthomier (*Congrès Francais de Chir.*, 1877, p. 322), by Hasle (Paris, "Thèse of 1892"), and by Barbacci (*Lo Sperimentale*, September 15, 1891). As in the other long bones, the favorite locations in the ribs appear to be close to their terminations. The disturbance and swelling due to lesions of this character near the head of a rib may give rise to a great deal of uncertainty in diagnosis. Berthomier has in his paper discussed the physical signs, differential diagnosis, etc. Salomon has reported the case of a man, twenty-one years of age, sick for ten days, who on the sixth day complained of pain in the right sterno-clavicular region, with swelling and fluctuation. On the tenth day inflammation of the lower lobe of the right lung was evident, and delirium, followed by death, occurred. On autopsy it was shown that there had been osteomyelitis of the sternum with perforation of pus into the right sterno-clavicular joint. I have myself seen three cases of acute or chronic lesion of this kind of the sternum, in which there was more or less disfigurement of the chest, though I cannot say it attained a degree of deformity which would attract attention when the patient was clothed. Several cases of considerable deformity due to this cause are, however, on record.

In the pelvic bones these infections occur rarely, but give rise to most serious symptoms when they do occur. According to the part involved and the arrangement of muscles, we will have posture-deformity of the thigh with fixation by muscle-rigidity, etc. This posture-deformity may even become permanent. Deformities from this source would be probably more often met with were it not for the fact that acute osteomyelitis of the iliac bones is followed by death in more than half of the cases.

Acute infection of the patella is by no means unknown, and has been seen in very young children, even to such an extent that almost total necrosis has resulted. In some instances, and very slowly, new bone has been reproduced to take the place of that which had been thus lost. It would appear in these instances as if the posterior cartilaginous surface of the patella served as the barrier by which perforation into the joint was prevented.

It is perhaps more often in the larger bones of the tarsus, particularly the calcaneum and the astragalus, that we meet with multiple but small foci, each of which is followed by limited necrosis, and which gives rise to what Ollier has spoken of as "disseminated necrotic ostitis."

Necrosis forms, by all means, the most common result of osteomyelitis. It may assume either of the following types, with corresponding variations in resulting deformity (Ullmann):

1. Peripheral or cortical necrosis, in which a more or less thick scale is detached from the external portion of the bone.

2. Central necrosis, connected with the marrow-cavity, at least, connecting that part of the bone which comes into direct contact with the bone-marrow.

3. A lamellated form, in which an intermediate portion of the compact substance dies and a sequestrum results which extends neither to the surface nor to the interior cavity.

4. Penetrating necrosis, where to some extent the entire thickness of the bone is involved, *i. e.*, from periosteum to centre.

5. Transverse necrosis, the same as 4, except that it extends completely around the bone.

6. Total necrosis, where the entire shaft is separated as a sequestrum.

7. A disseminated form, particularly described by Ollier.

Necrosis concerns us here as orthopedists mainly in this: that it produces in many instances a weakening of the bone which may lead either to fracture-deformity or curvature. Spontaneous fractures of necrotic bone have occurred under my observation; and I remember one case of necrotic femur which broke as we were lifting the patient upon the operating-table.

Incidentally, there is danger of cancer in some of these cases, for Volkmann collected thirty-two cases in which old and fistulous passages became the site of epitheliomatous changes, and in which cancer was the final result.

DISCUSSION.

Dr. James E. Moore. The paper of Dr. Park is a timely one, because the tendency at the present day is to call everything in the way of inflammation of bone tubercular. He very pointedly brings out the fact that we do have acute tuberculosis sometimes, which is overlooked. He also brings out the fact that many of these acute inflammations are non-tubercular; that the joint is endangered when inflammation begins in the epiphysis, something that is commonly overlooked. Time and again we have been called to see cases where the joint was destroyed. Had the acute osteomyelitis been treated properly, the joint might have been saved. These are practical points that should be impressed upon the general practitioner by the orthopedist, because the former is apt to treat these cases, even when he knows there is inflammation of bone, as cases, perhaps, of rheumatism, etc., until we find the joint practically destroyed.

Dr. Royal Whitman. The reader brings out one point which particularly impresses me, and that is the impossibility of separating or divorcing mechanical from operative surgery. Dr. Park realizes the fact that many of these cases have been operated on for acute affections, and must also be treated mechanically for a certain length of time if the best result is to be attained. On the other hand, great damage is often done by

extension of the disease into the joints, which might have been prevented by a timely operation. At the Hospital for Ruptured and Crippled we have many of these intermediate cases—that is, cases that should be operated upon, and then treated mechanically.

Dr. Park. Most of the members of this Association are teachers in medical colleges, and while they do not see these cases in the early stages, they nevertheless do see the results of them. In the paper it was my object to urge the necessity on the part of the practitioner of prompt interference in these cases in their incipiency. I firmly believe that if they were properly handled at the outset there would be a much smaller number of them coming to our orthopedic clinics. That is the primary lesson of the paper. The idea is not that orthopedic surgery should be divorced from general surgery; they go hand in hand.

DISABILITY FOLLOWING FRACTURES OF THE LOWER THIRD OF THE LEG AND THEIR TREATMENT.

By JAMES KERR, M.D.,
WASHINGTON, D. C.

Joint-disability following fracture is of most serious import when affecting the articulations of the lower extremities, because associated with pain and physical incapacity, tending to increase as age advances, and not infrequently resulting late in life in complete decrepitude.

The causes of this have been long recognized and perhaps best described in the original monograph by Percival Pott, who, in speaking of the effect of the fracture that goes by his name, says: "The due and proper use and execution of the office of the joint depend almost entirely on the perpendicular bearing of the tibia on the astragalus." The disability to which I wish to draw the attention of the Fellows is, perhaps, more marked in the case of this joint than elsewhere, and the fractures that more frequently induce it are Pott's fracture and the oblique fracture of the lower end of the tibia.

These effects seem to depend on alterations of the normal articular relations by which the weight-pressure is thrown off the normal axis and bears unduly on one side of the joint, producing at first a feeling of insecurity, and later pain and lameness. The extra-articular structures, capsule, ligaments, and tendons are subjected to strain corresponding to the amount of axial deviation. Arbuthnot Lane, in a very important contribution to our knowledge of fractures of the leg, says that physical incapacity follows in the case of laborers in a proportion of 70 to 80 per cent. in oblique fractures of the bones of the leg, and cites forty cases collected among hospital patients in support of this statement, and most of us have met with such cases among those who lead laborious lives.

The following is from the paper read by Mr. Arbuthnot Lane, April 13, 1894, before the Clinical Society of London.

He believed that the average financial depreciation of the laborer as a machine after such an injury amounted to nearly 70 per cent. of his original value. This he thought due to alteration in the lines of pressure through the several joints of the lower extremity, resulting from deflection of the lower fragments from their original relationship to the upper. In consequence of this alteration insecurity and pain were experienced in the joints, especially the ankle and foot, and increased with the age of the individual. Pathologically there was a progressive mechanical arthritis in the joints. Mr. Lane consequently advocated operative measures entailing a minimum of risk to the life or limb of the patient by which the fragments could be brought into apposition and so retained with perfect accuracy that the skeletal mechanics of the individual remained as perfect after the injury as they were before. He cut down on the fracture of the tibia and exposed the broken ends freely, removing any tissues intervening between the sectional surfaces, bringing these surfaces into accurate apposition, partly by traction on the foot, partly by means of elevators, and partly by means of lion forceps, by which last instrument apposition was continued till holes had been drilled and the bony surfaces brought together immovably and forcibly by the introduction of steel screws. He read notes of three cases which he had operated on in the same week. The results were extremely satisfactory, since the fragments had united perfectly. The paper was supplemented by a brief account of forty cases collected by Mr. F. J. Steward, which fully bore out the truth of Mr. Lane's statements.

If these statements are in accord with the facts, the routine methods of treatment in fractures of the leg call for revision. The mistake arises mostly from treating all fractures of the leg in the same way without regard to the special pathology of each. The two classes of fractures that I am now dealing with cannot be managed without serious ultimate results to the usefulness of the limb by the methods most generally advised, namely, in box-splints, plaster-of-Paris, or any method by which the limb is kept in the straight position and foot not adjusted and maintained so as to meet the special indications of either fracture. Fracture of the fibula with

fracture of the internal malleolus, or rupture of the internal lateral ligament, requires muscular relaxation and inversion of the foot.

The oblique fractures of the tibia require the same regard to muscular tension and *eversion* of the foot. Special indications to meet such displacements as backward position of the foot in the former and forward riding of the upper fragment in the latter are required, but it will be readily seen how frequently any general routine method must result disastrously.

These evil consequences of maltreatment are most often found following Pott's fracture and are common at any age and to all classes. The characteristic deformity, the axis of the leg making an angle with the foot, best observed from behind, as Langenbeck has pointed out, the lameness and tarsalgia make a striking clinical picture too frequently met with.

The oblique fracture of the lower third of the tibia is not of so common occurrence and the deformity and incapacity not so marked; a consideration of its pathology, however, shows that this is due not to correct methods of treatment so much as to the fact that the axis of the ankle can only be displaced to the limited extent that the upper end of the lower fragments can encroach on the interosseous space.

The variety of fracture to which I allude occurs usually at the junction of the lower with the upper two-thirds of the tibia, and is produced by falls on the feet—in fact, it is a fracture by "contre-coup." It is commonly caused by jumping from a moving vehicle, and is not infrequently a result of runaway accidents. The line of fracture is from without inward and from above downward; the lower end of the upper fragment is displaced inward and forward, the upper end of the lower fragment outward into the interosseous space; as a result, the inner malleolus is raised, the articulating surface of the tibia that was at right-angles to the axis of the limb is inclined obliquely upward and presents a modified converse to all the conditions that exist in Pott's fracture, the articular relations being altered so as to throw the axial weight-line outward instead of inward, as in Pott's fracture. This fracture of the tibia is usually associated with fracture of the fibula high up. Here, as in Pott's, much can be done by proper conception of the pathology and carrying out correct principles of treatment; but where these have

not been adopted the same expedient will apply for correcting its resulting deformity that I have to suggest for the other, but it must be comparatively rare that an osteotomy will be demanded for this latter injury.

Fig. 1.

Case I.—Showing result of supra-malleolar osteotomy for deformity following Pott's fracture. (Kerr.)

To this particular fracture Lane's suggestion would apply with particular force. There is perhaps no other where incapacity is more likely to ensue. It is beyond question that the routine methods of treating all fractures of the leg alike, more especially trusting them to plaster-of-Paris dressings for long periods without opportunities for inspection, are responsible for these results. It is

also a fact that the ultimate result of a fractured limb is often in strong contrast with the immediate result. Certain changes ensue within the joint—"progressive mechanical arthritis"—as age advances, and which are usually attributed to rheumatism.

FIG. 2.

CASE II.—Seen from in front. Supra-malleolar osteotomy for Pott's fracture deformity. (KERR.)

The operations hitherto devised for the correction of Pott's deformity include refracture by subcutaneous drilling of the fibula and internal malleolus at the site of fracture, subcutaneous osteotomy and open osteotomy at the same localities, and Fenger's supra-malleolar osteotomy by removal of a wedge of the tibia and wiring.

These casts, taken from cases operated on by me, will demonstrate the result of a still simpler and, I submit, equally effective proced-

ure for the correction of this condition. It consists of a simple linear supra-malleolar osteotomy of the tibia alone, similar to—in fact, identical with—the Hahn-Langenbuch procedure for the correction of valgus. The fibula was not touched, relying on its flexi-

Fig. 3.

Case II.—Seen from behind, showing result of linear supra-malleolar osteotomy for deformity following Pott's fracture.

bility after the tibia was divided to restore it to its proper relation toward the interosseous space. Examination of the cases also will demonstrate the complete restoration of the normal axial relations between the leg and the foot, which is the sole object of treatment. The broadening of the articulation, which is one of the causes assigned for this disability, is corrected by the bringing inward of the

external malleolus as the upper end of the lower fragment of the fibula is drawn out when the foot is inverted after the tibia has been divided, and I can see a positive objection to the refracture of the internal malleolus, as its abnormal and uncorrected dis-

FIG. 4.

CASE III.—Showing result following supra-malleolar osteotomy for Pott's fracture deformity. (KERR.)

placement will prevent this broadening of the inter-malleolar space. Backward displacement of the foot, a common result of Pott's fracture, can be partially restored, as well as the rotary displacement described by Hamilton.

We have, therefore, a simple, safe expedient within the capacity of anyone capable of accomplishing any ordinary surgical operation according to modern standards that will only confine the patients a

Fig 5.

Case III.—Showing result (seen from behind) following Pott's fracture deformity after supra-malleolar osteotomy. (Kerr.)

few days to bed, and with the aid of massage will give them the use of their corrected limb in from four to eight weeks, according to their age and the degree and length of time of pre-existing disability.

It is hardly necessary to add that following the osteotomy the foot has to be placed in a position of over-correction, as it should be treated primarily.

DISCUSSION.

Dr. Reginald H. Sayre. I do not think there is any doubt that a great deal of disability is often caused by Pott's fracture, and that it is primarily due to bearing the weight on the foot at an improper angle, as shown in these casts. The only sensible method of treatment is to put the foot back in its normal position, and the operation recommended is an extremely good one for the relief of these cases. There is one point on which I would take issue with the essayist. Why we should have a good result after an artificial fracture and a bad result after an accidental one I cannot see, except that in one case the fracture was properly treated and in the other case it was improperly treated. If you have broken a leg artificially with your hand, an osteoclast, or with a chisel, you put the bones in proper relation to each other and hold them there until nature has mended the break. The same thing should be done in a case of accidental fracture that comes under your charge. The suggestion that these cases must be treated with cutting down upon them, scraping out the fragments, nailing or screwing the ends of the bones together in order to maintain accurate apposition, is not borne out by the results the essayist himself has had in his cases where he adjusted the bones, secured proper apposition, and kept them there until nature had a chance to repair the damage. I cannot see why Mr. Lane should have raised so much objection to the treatment of these cases in plaster-of-Paris dressings. One of the best modes of treatment of fractures of almost all kinds is by plaster-of-Paris dressing. It is more easily applied, more accurately adjusted than anything else, and is a very handy, convenient material to use. I think the old-fashioned way of treating fractures which is in use in England at the present day, but in this country has been abandoned, is responsible for such results as we see here. If proper, intelligent treatment is instituted in the beginning in these cases, they ought never to result in those deformities which Dr. Kerr has been called upon to relieve, and the mode of treatment adopted by him after his intentional fractures ought to give equal results in the hands of those practitioners who see these cases in the first place.

Dr. James E. Moore. I have frequently resorted to the older operation of fracturing the tibia and fibula. If, as the Doctor suggests, we can accomplish the same result without fracturing the fibula, it is very desirable. I can see no objection, however, to fracturing the fibula if one is in doubt.

I must take issue with Dr. Sayre when he maintains that we can reduce a fracture the same as treating the original fracture. It is a different matter. The original fracture is an oblique one, and one which is disposed to decided displacement. Personally, I would rather treat a Colles' fracture than a fracture of this kind, because there is this difference between the two, namely, that after having once reduced the displacement there is little tendency to return. But that is not true of the fracture under consideration. I agree with Dr. Sayre in this particular, that there is no treatment, no splint, we may say, that is equal to plaster-of-Paris in the treatment of these cases. Where boards or box splints are used in the treatment of these cases, when the patient walks the fragments are apt to be displaced. Having once properly adjusted the fragments, there is nothing that will hold them so well as a nicely fitting plaster-of-Paris cast.

Again, it seems to me unnecessary to do a cuneiform osteotomy; a simple transverse osteotomy will accomplish the desired result.

I wish to emphasize one point, namely, it is an easy matter to find fault with those who have treated these fractures. I must admit I have had some unsatisfactory results in these cases, when I have had everything my own way and where the fracture has not been compound.

Dr. Arthur J. Gillette. My experience has been limited to one case, and I did not have so much deformity as is shown here. I was surprised to find that by manipulation, while under an anæsthetic, I got the foot in good position without making a fracture of the bone.

Dr. Royal Whitman. Dr. Sayre has spoken of plaster-of-Paris dressing in the treatment of these cases. It does not seem to me that the plaster-of-Paris bandage ought to be allowed to remain for six or seven weeks, but should be removed for a final

inspection of the limb before consolidation of the fracture is complete, so that deformity, if present, might be corrected. Another point, I have often noticed that when these patients are permitted to leave the hospital they very often suffer from pains in the foot, which may be relieved by building up the shoe on the inner side. In those cases in which the leg is dislocated forward on the foot, I should be inclined to think that the deformity would be more difficult of treatment.

Dr. James Kerr. I readily see that it is quite impossible to reconcile the different methods of treating fractures. I quite agree with what Dr. Sayre has said regarding the plaster-of-Paris treatment, but there is an objection to it. I do not care how accurately adjusted the fragments may be. The fracture, if left to itself inside of the plaster-of-Paris casing, will get out of place. If the plaster-of-Paris dressing is applied immediately after the fracture, and at the end of the first week, after swelling has subsided, and again before consolidation has taken place, you can supervise the process of repair with the plaster-of-Paris, but even then more or less deformity will sometimes result. I said in my paper that many of these bad results were attributed to the plaster-of-Paris being left on for weeks together, and when taken off it is found that the patients have crooked ankles and crooked limbs. If a linear osteotomy is done on the tibia, I do not think it will be necessary to touch the fibula. In these cases the relations between the astragalus and tibia are altered, and until they are replaced by refracturing of one or both bones we cannot hope to obtain a good result. I am now speaking of well-marked cases of deformity following Pott's fracture.

I think Dr. Sayre will agree with me that it is absolutely impossible to restore all these cases of great obliquity and distortion to that accurate coaptation that is essential to give the same articular relations that previously existed. Where we cannot get such relations between the articular surfaces Lane suggests immediate exposing and fixing, and I believe this is founded on proper pathology and justified by modern research.

Macewen, in 1887, was wiring nearly every case of simple fracture of the femur. He admitted that it was an impossibility to

get coaptation of femoral fractures. A good result in fracture of the femur does not necessarily imply entire absence of shortening. You cannot have an oblique fracture of the femur without some shortening. It is because of the difficulty of securing actual restoration of the original condition in these fractures, and because of the degree of disability following, that Lane makes this suggestion of wiring and screwing the fragments together.

THE TREATMENT OF POTT'S DISEASE.

By ROBERT W. LOVETT, M.D.,
BOSTON.

Pott's disease is in itself only a tuberculous destruction of the anterior part of the bodies of the vertebræ. No deformity is necessarily associated with its occurrence, and the antero-posterior curvature of the spine, with which we always associate it, is really the result of the erect position. It is said that this deformity does not occur in quadrupeds.

The present paper is an attempt to formulate certain problems which are met in the treatment of this affection by ambulatory means.

When a surgeon in starting to treat a case of Pott's disease by ambulatory methods selects the force of gravity as his antagonist rather than as his assistant, it is proper that he should appreciate the problem which he is undertaking and understand clearly the mechanical aspect of the case. Instead of keeping the patient with Pott's disease in bed, if the surgeon allows him to go about so that the heavy weight of the body comes upon the diseased segment of the vertebral column, the surgeon should know pretty definitely whether this is a matter that he can counteract by apparatus or whether any mechanical support to the spine is necessarily imperfect.

The question is this: Can the spine be placed in as favorable a condition for recovery as during recumbency, and what is the mechanical value of the methods of ambulatory treatment now in use?

To consider, for example, a case of dorsal Pott's disease in a boy weighing forty pounds, where the disease is located in the lower dorsal vertebræ, say the ninth, tenth, and eleventh. It is manifest that inasmuch as the vertebral column bears all the body-weight,

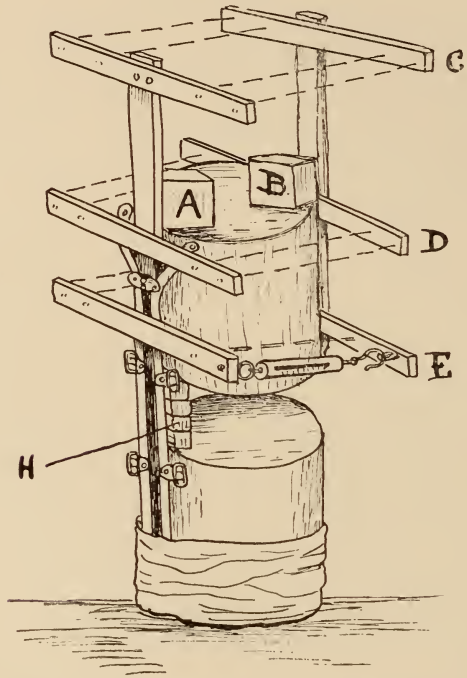
and as the vertebral column is normally convex backward in the dorsal region, the weight of the body above the disease must needs be transmitted through the bodies of the dorsal vertebra. This weight is the weight of the segment of the body above the diseased vertebræ. It includes the head with the brain, the neck and its firm muscles, the shoulder-girdle from which hang the arms, which are of no little weight, and the upper part of the chest with the contained organs. There is no support in front. These organs are hung simply from the backbone, from which the chest-girdle runs out just as a cross-bar does from a telegraph pole. It is not a bad estimate, I think, to place the weight of these organs which I have just mentioned as half the body-weight, in this case twenty pounds. We will assume then that the problem in this especial case is to modify, if possible, the pressure which comes from this weight upon the diseased vertebræ, and that this pressure is the result of a twenty-pound superincumbent weight.

The problem which efficient mechanical support must solve is to remove or lessen the weight coming upon the diseased bodies of the vertebræ. The antero-posterior brace attempts to do this by acting as a lever which shall transfer the weight to the articular and transverse processes by pushing against the deformity as a fulcrum. In other words, it should modify intervertebral pressure. It is upon this theory that the brace was constructed and should be used.

The model which is presented is a very imperfect affair, but one which makes very clear some of the intrinsic difficulties met with in the treatment of Pott's disease. This model was made as follows: A plaster jacket was applied to a patient and removed. After removal the jacket was bandaged together and filled with plaster-of-Paris paste, which hardened into a rough cast of the trunk. This cast was sawed in halves transversely, and by putting in some blocks of wood at the back to represent the vertebræ, H, if these two halves are placed as shown in the picture, the conditions of a case of mid-dorsal Pott's disease are fairly well represented. (Fig. 1.) A Taylor back-brace is applied by being bandaged to the lower segment and running up just as it would in the case of a patient. It is made to exert force at the point represented by the blocks of wood just as it would press forward upon the deformity. The upper part of the brace is bandaged to the top segment. These two segments

of plaster represent the two segments of the body above and below the disease, and the problem is to determine what force must be applied by the brace to keep these segments in place. This would correspond to the force required to modify the intervertebral pressure, and this modification of the intervertebral pressure should be what the surgeon should strive to accomplish in all cases of Pott's disease treated by this brace.

Fig. 1.



Model to show mechanics of antero-posterior brace.

The criticism may be made that this model does not reproduce the muscles. The only muscles which come in question are the intrinsic muscles of the spine, and they work to such a very great disadvantage in comparison with the leverage that the weight obtains that they may be disregarded as of practically little importance. They could have been represented by rubber cords running along

the back of this model, but it is evident that such apparatus would have very little practical influence upon the experiment.

The posterior muscles of the trunk may tilt the body backward, as often happens, but this acts only to bring the superincumbent weight further back, and will be discussed later.

The upper part of this model weighs ten pounds, and a ten-pound weight is attached to it, which represents fairly well the conditions in a case of lower dorsal Pott's disease in a boy weighing forty pounds. An arm runs out from the back-brace, and other arms run out from the front of the upper part of the model. These are connected by spring balances which show how much pressure is required at different levels. They show how much force will be required to hold the upper part of the model back. Three points can be demonstrated by this model.

1. If the chest is firmly held and the pelvis is held with equal firmness, the pressure coming upon the spine over the disease, in case the brace were used to modify intervertebral pressure, would be so great that no skin would be able to stand it. If the finger is placed between the back-brace and the wooden blocks in the model which represent the diseased column, it will be found that even when the upper segment weighs only twenty pounds the pressure cannot be borne. It simply demonstrates the necessarily incomplete action of the brace, for, if it were possible for the pelvis and chest to be held as firmly to the brace in the living subject as in this model, the skin would not be able to stand the pressure. It is obvious that the pelvis and chest cannot be held as firmly as in this model.

2. The position of the superincumbent weight is a most important matter. If the ten-pound weight is placed at A, that is, as far back as possible, the spring balance at D registers ten pounds. If, however, the weight is placed at the forward part of the model, B, the balance registers nearly twenty pounds, demonstrating that the position of the superincumbent weight, that is, of the head and shoulders, is a most important matter in determining the amount of weight to come upon the diseased vertebræ. Therefore, if the head and shoulders are held as far back as possible, in this way it requires much less pressure to make the brace efficient than when the head and shoulders droop forward.

3. The level at which the backward pull is applied is a most important matter. In this experiment the spring balances are adjusted at the level of the axillæ, D, and the transverse pull is made practically at the level where would come the highest transverse straps of the apron. If the pull is made at a lower level in the model, E, so great an amount of force is required to hold the upper part

Fig. 2.

Side view of a patient with mid-dorsal Pott's disease, showing the position of the upper segment and the manifest impossibility of supporting it by the simple antero-posterior brace.

of the model in place that it cannot be registered by the balances in use. If the two arms are prolonged up to what would perhaps be the level of the middle of the face, C, much less force is required to hold the upper segment of the model in place than when pressure is made backward at the axillary line. That is, the higher the

backward pressure is applied the less force is required to hold the upper part of the model in place.

The practical application of this experiment is as follows: In the living subject it is not possible to obtain a sufficiently firm hold upon the chest and pelvis. If it were, the skin over the deformity would not be able stand the force required to modify the intervertebral

FIG. 3.

Anterior support to be used in connection with antero-posterior brace in dorsal Pott's disease.

pressure. The Taylor back-brace, as ordinarily applied, exerts no backward pull above the axillary line where a very great force would be required to pull the upper segment of the body backward. (Fig. 2.) The chest-piece of Dr. Taylor, which applies backward pressure in the fossæ under the clavicles, is in the right direction. The

apparatus of Dr. Whitman, which makes pressure upon the anterior part of the shoulders, is also in the right direction, but incomplete and incapable of exerting proper pressure. If a firm hold could be obtained upon the chest, a brace would be able to accomplish much more than is found to be the case now. The chest-piece used by the writer, which is practically an anterior brace to the chest, is shown in the diagram. It is an effort in the direction of obtaining this hold upon the chest and is partly satisfactory. (Fig. 3.)

With regard to the mechanical efficiency of the plaster-of-Paris jacket in Pott's disease, a different method of experiment was undertaken. If the plaster jacket diminishes the deformity or extends the spine when applied, it must necessarily cause lengthening of the body. If the plaster jacket can accomplish as much or nearly as much as is done by having the child lie on its back, the length of the child should be as much after the application of the plaster jacket as when lying down. Some preliminary experiments were made with regard to the effect of recumbency in increasing the length of children with Pott's disease.

1. A boy with lumbar deformity was one-quarter of an inch longer when lying down.

2. A girl with dorsal deformity was one-half of an inch longer when lying down.

3. A girl with lumbar deformity was one-quarter of an inch longer when lying down.

4. A girl with acute dorsal disease was seven-eighths of an inch longer when lying down.

5. A girl with high dorsal disease was seven-eighths of an inch longer when lying down.

These experiments show that a child with Pott's disease is from one-quarter to seven-eighths of an inch longer in recumbency than in standing. This difference can be largely accounted for by the change in the curves of the spine.

An experiment was then undertaken to see if the plaster jacket caused lengthening of the child, and, if so, under what circumstances.

1. Jacket applied by suspension. The immediate effect was an increase in the length of the child five-eighths of an inch over the standing position, but at the end of twenty minutes the child had

shortened three-eighths of an inch, and at the end of thirty minutes was back to one-eighth of an inch of the height when standing with no apparatus. In other words, the application of a plaster jacket lengthened the child only one-eighth of an inch. It may be mentioned incidentally that the child when lying on its back was one-half of an inch longer than when it was standing up with a properly applied plaster jacket.

2. A jacket was applied to a child with the effect of immediately lengthening it over the standing position. At the end of twenty minutes the child was at the same height as when standing without the jacket on, and was seven-eighths of an inch shorter than when lying on the back in bed. The jacket was applied by suspension.

3. A jacket was applied by the hammock method: Standing without support, 3 feet $2\frac{1}{2}$ inches; ten minutes after application of jacket, 3 feet $2\frac{3}{4}$ inches; twenty minutes after application of jacket, 3 feet $2\frac{1}{2}$ inches.

4. Jacket applied by the hammock: standing without jacket, height, 3 feet $4\frac{5}{8}$ inches; immediately after application of jacket, 3 feet $4\frac{3}{4}$ inches; ten minutes after application of jacket, 3 feet $4\frac{5}{8}$ inches.

In no one of the four experiments was the child substantially longer after the careful application of the jacket than when standing unsupported, and in no case as long as when lying down without apparatus.

The column is longest and the spine consequently straightest when the child is suspended or has traction applied in bed to the legs and head. A boy with mid-dorsal disease, not very acute, was an inch longer in bed with traction than when he stood up. A girl with high dorsal disease and paralysis was lengthened three-eighths of an inch by traction over her length when lying quietly in bed.

The spine is in its second best position when the child lies in bed without traction. The spine is shortest, and consequently in its worst position, when standing, and the application of a jacket has not in any case observed by the writer been found to produce any permanent increase in height except in one case where it lengthened the child one-eighth of an inch over the position without a jacket. The same may be said of the application of the antero-posterior brace. Recumbency, on the other hand, does produce such an in-

crease in length. To the writer's mind the case is clear. Recumbency with traction is the best available treatment if we regard only the position of the spine. Simple recumbency is the next best. Treatment by ambulatory measures is the worst. These are demonstrated by the length of the child under these various conditions.

Recumbency. With regard to the treatment by recumbency I am as far as anyone from wishing to advocate unnecessary recumbency, but I wish to go on record as advocating in general during the acute stage of Pott's disease recumbency on a frame for the greater part of the time, varied by short periods of going about protected by the most available brace or jacket. During the painful stage I believe that recumbency should be continuous. The beneficial effect of recumbency must be familiar to every orthopedic surgeon, who must often notice the improved appetite, the increase in flesh, and the diminished fever when a child with acute Pott's disease is put to bed.

In the use of apparatus it should be remembered that it is all necessarily imperfect from a mechanical point of view, and does not afford complete support, and that traumatism to the spine must result from the use of the jacket or the brace. The more complete and efficient the apparatus, the less the traumatism.

Such are the scattered facts that I have brought together for your attention. Pott's disease, it seems to me, is a very grave affection, and in advocating its treatment by recumbency rather than by ambulatory measures during the acute stage, I am speaking of what I believe to be the very best treatment. Other modes of treatment are no doubt excellent, but when one wishes to secure the very best result, it seems to me that having recognized that apparatus is intrinsically imperfect, and necessarily so, to accomplish the purpose for which it is intended, that it is incumbent upon the surgeon either to insist upon this treatment by recumbency or to transfer the responsibility of ambulatory treatment to the parents. The use of apparatus, it seems to me, should be during the acute stage to vary the monotony of recumbency. That recumbency should be carried out by having the child lie upon its back upon a frame. The addition of traction to the legs and head I believe to be of benefit, and that it hastens recovery by quieting muscular spasm

and improving the position of the spine. I believe that it should be used in all cases of paralysis due to Pott's disease.

With regard to apparatus, whether we use it in the way that I have advocated or as the sole means of treatment, it seems to me that we should remember that apparatus is necessarily mechanically inefficient to solve the problem which it undertakes. If apparatus is used, these points should be remembered. The position of the superincumbent weight should be as far back as possible, and the higher the backward pull comes the less force is required, whether a jacket or a brace is used.

Whether we wish to follow the best treatment or not may be a question, but it is the writer's belief that treatment by recumbency, so prevalent in the early days of orthopedic surgery, will come again to the front if the real value of supporting apparatus is studied.

DISCUSSION.

Dr. A. J. Steele. The ambulatory treatment of Pott's disease with spinal braces, jackets, etc., is a delusion and a snare. I came to this conclusion some six or eight years ago, when I saw the result of my own and the treatment of others by these means. Dr. Lovett has demonstrated to us, without peradventure or doubt, the reason why these apparatus are not so useful as one would seem to think. Dr. Davis a long time ago told us that the object of treatment was to take the weight from the bodies of the vertebræ and throw it upon the articulating processes, and then the patient might walk about; but he was wrong. I believe, as the author of the paper concluded, that the proper treatment of Pott's disease is recumbency, either on a frame or stretcher, especially in the acute stage. I hardly think traction is necessary unless the trouble is in the upper cervical or lower lumbar vertebræ. When lying, the weight of the body acts as an extending force as you increase the pads on either side of the boss within the plaster-of-Paris jacket, which latter is necessary to prevent lateral movement. We thoroughly immobilize the vertebræ and take off the weight of the body. I have had patients lying in the recumbent

position for eleven or twelve months whose general health continued excellent. It it remarkable how well they keep. The stretcher that I use in the treatment of these cases can be carried out in the sunlight with the patient on, and can be transferred from room to room. I do not believe it is necessary that young children should be allowed to walk and run about as far as their general health is concerned.

I am very much pleased indeed with the demonstrations of Dr. Lovett, and I urge and warn the younger orthopedic surgeons to avoid the unfortunate experiences some of us have had. It is better to put patients with Pott's disease on their backs on the frame, which has been so perfected that all the objections of any consequence have now been removed. If it is necessary to remove the child from the stretcher, it can be done by rolling the patient on his face, carefully taking off the jacket, washing the spine, and placing the patient back again, so that no harm comes either to the patient or to the diseased vertebræ.

Dr. Arthur J. Gillette. I want to take exception to one remark and one illustration. I believe Dr. Lovett stated that straps for over the shoulder should not be considered. I do not understand why. I am aware we cannot put anything like the amount of pressure by tightening of these straps that you can across the chest, but I do believe that there is a certain amount of pressure, of pulling back, and by throwing the shoulders back it will bring the backward traction higher. I believe it takes away a great deal of the tendency to stoop forward. It cannot help it.

The illustration of placing Dr. Sayre's finger between the block of wood and the brace was to show, I presume, that the skin would not bear that amount of pressure. If the brace fits properly all the way at the back, it acts not only by drawing backward, but acts also as a splint.

Dr. Lovett. With regard to the point made by Dr. Gillette concerning the brace, I will say that it is a leverage brace; that it takes pressure off by acting as a lever. That, I understend, is the original claim for it, and however it may act as a splint, it can

only transfer weight by acting as a lever with the deformity as a fulcrum.

Dr. V. P. Gibney. The paper of Dr. Lovett interested me very much, because it is a scientific demonstration of the results of apparatus of all kinds, and while he was reading his paper I was going over in my mind some of the results we have had at the Hospital for the Ruptured and Crippled. It has been a matter of common observation with us that children on whom braces and jackets have been applied, when put to bed for a while, improve, feel happy and comfortable, but after a while they do not get on so well, especially as do other children, and unless one is careful with the apparatus Dr. Steele has described and fastens them down to a frame, it is next to impossible for the nurse or nurses, however well trained they may be, to keep such children always in position. They must use a bed-pan occasionally, must be cleaned when friends come to see them, must turn over in bed and talk to others. Unless you have some sort of fixation-apparatus, as a steel frame, you cannot always carry out absolute recumbency. It seems to me that these little twistings, interruptions, so to speak, very often do a vast amount of harm which we cannot overcome by any amount of recumbency in bed. We find patients who do not get along well in jackets unless they are comfortably fitted. Then we have cases in our out-patient department for which we must devise some means by which they can get about and around. You cannot keep them in bed; for there are urgent cases seeking admission, and we cannot keep them there indefinitely, and for that reason we must resort to ambulatory treatment. So much in confirmation of the experiments demonstrated.

With regard to the forms of apparatus employed, in the hospital we have practically admitted that the plaster-of-Paris jacket or corset is useful. We may also use the Taylor brace with shoulder-pieces, and a great many will use the method after Dr. Whitman's plan. Most of us have a method of treatment, and we follow that out to the best of our ability. It has seemed to me that nothing is quite equal to a good plaster-of-Paris jacket in the early stages, and also for those cases where relapse has occurred, or where some

focus of disease has seemed to be accentuated. There is nothing so gratifying to me and to the mothers of patients I have treated in private practice as a light, solid plaster-of-Paris jacket. Yesterday afternoon I was talking with Dr. Phelps, who asked me about a case that he had formerly treated. I told him I was using a plaster-of-Paris jacket, and he said he wanted the patient to do that all the time. I have seen this happen; that with a posterior spinal steel brace, no matter how well adjusted, patients will get to one side, walk awkwardly, begin to favor one limb, and psoas abscesses result, and the patients will be unhappy. I much prefer in private practice to use a steel brace. I think it has this advantage: It does not produce so much atrophy of the muscles, it leaves the muscles uncompressed, and we reach the convalescent stage sooner. We know we can get a snugly fitting jacket. It is a long time before we can wean them of that. Time and again I have tried to go back to the steel brace, and in the great majority of cases I have been compelled again to resort to a plaster-of-Paris corset. During the convalescent period I leave it off at night, and gradually am able to wean them in that way.

In regard to the remarks of Dr. Brackett bearing upon adult caries, in a paper read before the Orthopedic Section of the New York Academy of Medicine Dr. Phelps remarked that it was very difficult to manage adult cases of Pott's disease, or that it was difficult to manage abscesses of adults in Pott's disease. That is a common experience. We often have occasion at the hospital to refer adult cases of this affection to some general hospital because we cannot take them into a children's hospital. Some one of the surgeons on duty is glad to get cases during the "teaching season" for demonstration, and he will welcome any case of spinal abscess from Pott's disease to demonstrate the feasibility of treating the case by open incision and drainage. A number of surgeons decline to take these cases in New York. A remark was made to me by two or three surgeons of wide reputation that all of these cases died. They do well for a time after operation, then become septic, run down, and no hospital will take them. They finally die of septicæmia. That experience is very common. So I have for a long time contended that we were not quite equal to the management of adult cases of Pott's disease,

especially when complicated by abscess. For a number of years it has been my practice to let these abscesses alone, that is, not incise them if I could possibly help it, but I have employed the aspirator from time to time. I know I am encroaching on dangerous ground when I speak of cutting these abscesses or leaving them alone. I want to impress upon you the value of the simple procedure of aspirating these abscesses from time to time, but not injecting iodoform thereafter. This treatment has yielded most gratifying results, and in this connection I would like to present a brief report of a typical case. It is one of those cases that we speak of as a *dernier ressort.* A case of that kind came to me several years ago, and has recently been discharged cured, so that I feel I can present it.

Case.—Kate R., aged twenty-two years. Referred to me December 28, 1892, by Dr. Hahn, of the Polyclinic. Diagnosis: Dorso-lumbar Pott's disease with psoas abscess of the right side. She has suffered for at least a year; has worn first a steel brace applied by Darrick, of Newark, for six months or more, then a solid plaster-of-Paris jacket, applied by Dr. Hahn for about two months. It did not give her enough support, she thought. It has been about three weeks now since she has had any support. Came to the clinic about two weeks ago with a typical history, a typical series of signs, for instance, rigidity, bosse, pains, and a large psoas abscess, with a history of pains down the thigh. The bosse is light, and the deformity really is not much. Advised to have a plaster-of-Paris corset, to have the abscess aspirated, and to remain quiet for twenty-four hours after the aspiration. So she is to have the jacket and aspiration to-day, and to remain at the Polyclinic, or boarding-house nearby, for twenty-four hours. Plaster-of-Paris corset applied at Polyclinic, abscess aspirated, and she takes a room in the hospital.

December 31, 1892. Is fitted with her corset. Has had no trouble from the abscess. Goes home with instructions, and is supplied with a swing. Requested to report every three or four weeks.

April 19, 1893. She has suffered a good deal for the past week or ten days. The pain is in the back and in the groin. Her

appetite is poor. She finds considerable difficulty in walking around. On removing the jacket to-day both abscesses can be easily made out, the right more easily. The left is aspirated and about three or four ounces of thickish pus withdrawn. The right is not so satisfactory. There is a good deal of thickened tissue that prevents the needle from going in, but she is relieved some. Is to remain in the hospital for twenty-four hours, have ice-bag, then go home as usual. Ordered to take a quart of milk and a half-pint of cream in the twenty-four hours.

July 20*th.* She is very much improved in her appearance; claims not to be able to get about much. The jacket has not been changed since June 3d, and the skin is in very good condition. Abscess in left iliac fossa can barely be recognized by palpation. Is aspirated, however, and about two ounces of rather thin pus withdrawn, some little blood with it. One on right side has not reduced much, but is aspirated and very little pus withdrawn, about an ounce only. The sac seems to be full of cheesy material or broken-down bone. The spinal deformity has not increased any. Jacket is in good condition. She is to have ice to the parts this morning, and to go home this afternoon.

October 5*th.* She was aspirated about two weeks ago, but it was a dry tap. Since then she has had no pain in her abdomen. Her back is in very good condition. As she stands in the swing and palpation is made, no tumor can be made out in the left iliac fossa, but one in the right fossa. The tumor is moderately large. Not aspirated to-day.

November 16*th.* Her general condition is very fair. Has some pain in the left side. Deep pressure in the iliac fossa detects a tumor which is fluctuating. Crowding the abdominal walls close down about the tumor, a good-sized needle is thrust into the sac, and while no fluid comes out in the barrel of the syringe, the needle itself is pretty well filled with pus. The right side aspirated, and about one and a half ounces of very thick pus withdrawn.

January 25, 1894. This morning, at the hospital, about six or eight ounces of pus withdrawn from psoas abscess on right side, and about ten or twelve ounces from that on the left. General condition is good.

February 28*th.* A new corset made to-day. Both abscesses are present. The one on the left side is not very tense. That on the right side is rather tense, but a needle fails to get any pus, only a little serum.

March 10*th.* A week ago to-day an attempt was made to aspirate one of the abscesses, but nothing was obtained. She had a new corset applied that day and started for home. Two days later Dr. Stimson, of the Chambers Street Hospital, telephoned me that she had been picked up in the street, where she had collapsed with pain, and was taken to the Chambers Street Hospital. They did nothing for her but put her to bed, and I took her into a private room at the hospital on the following day. We could find nothing active about the abscess. She had no rise of temperature, but was suffering a good deal of pain at times. She has had the ice-bag applied to the abdomen over the regions of the abscesses, and has had the back fired and strapped with adhesive plaster. Yesterday she felt much better. Last night she had a violent attack of pain, requiring two or three doses of morphine and two or three doses of whiskey. She is advised to remain in the hospital longer.

19*th.* She goes home to-day very much improved, because of the removal of about eight ounces of pus from the left side and four from the right on two occasions.

April 9*th.* Aspirated and eight ounces of pus were withdrawn from the left abscess and two from the right.

May 7*th.* Attempted to aspirate this morning. On left side needle was plugged with shreds and aspiration unsuccessful. On the right side about three or four ounces of pus were withdrawn.

10*th.* Has a new corset made which seems to fit pretty well. The old one gave her very little support.

26*th.* Both abscesses aspirated this morning. From the one on the right side about six or eight ounces of dark-colored pus, and from the left side about three ounces, were withdrawn.

October 26*th.* She has been complaining of a good deal of pain lately in the right iliac fossa, and on deep palpation fluctuation is made out. The needle is thrust through the soft parts down to the cavity, and about one and a half ounces of greenish-colored

fluid of rather thin consistency withdrawn, toward the close some flakes. She bears it very well.

November 26*th.* She has been in the hospital now for four or five days, and a few days ago a new plaster-of-Paris corset was made, but it does not quite give her the support she seems to need. Extra padding put in to-day. The abscess in the right iliac fossa is aspirated, and about three or four ounces of thin pus withdrawn. There is a good deal of air in the syringe from some cause or other. She complains of the abscess on the left side paining a good deal, but I do not seem to get sufficiently well-marked fluctuation to justify an exploration.

December 27*th.* Two or three weeks ago she was fitted with a plaster-of-Paris corset that gave her support throughout, and that made her feel quite set up. She has been aspirated recently two or three times, but very little pus obtained, and from appearances it would seem that the sacs are pretty well emptied.

March 18, 1895. She is better now than she has been for years; walks and goes about easily; eats without any difficulty whatever. She seems to have plenty of room for food. She feels active; sleeps well; and has no pain on either side. Has just been to Philadelphia, and experienced no trouble in riding on the cars. On removing the jacket there is no excoriation anywhere except at the bottom part, where the jacket seems a little long. It fits her over the kyphos perfectly. There is very little fulness in either iliac fossa. Difficult to get any fluctuation. She has very little spinal tenderness. Paquelin cautery is employed this morning; she is washed and fixed up, and is to report in about six weeks or two months.

July 24*th.* She has gained flesh a little. No sign of any abscess to be felt. Is working a little now, that is, she knits in crochet work two garments a day at 4½ cents a piece.

Last spring the patient told me that she had had thirty-two aspirations altogether. There is no sign of any fluctuation in the iliac fossa I simply present this case as a very bad dispensary one, which I saw at long intervals. I feel with the other speakers that when we can get a perfectly fitting jacket, such as I have had here, we can get good adequate support. To open an abscess in an adult case of Pott's disease, no matter how careful

you are with your antiseptic technique, is a very serious question, and unless you can have almost continuous charge of dressing the case—that is, have every dressing carefully attended to—your patient will surely sooner or later get sepsis and die. In treating Pott's disease I have had no difficulty in managing the cases on these lines, and I use a plaster-of-Paris corset. I do not use a wood corset, because plaster is light enough and answers the purpose fully as well. The wood corset is much more expensive than plaster, and you do not feel that you are going down in your patient's pocket or your own. You must necessarily spend a certain amount of your own money in getting a wood corset made. The points I would emphasize are these: That in adult Pott's disease we can treat the cases as ambulatory ones, and it is unnecessary to put patients to bed. Men will not stand it as well as children, and the disease is such that we must resort to some apparatus.

Dr. Newton M. Shaffer. I wish to discuss briefly some points in Dr. Lovett's paper. I think we all must recognize the fundamental criticism he makes regarding any spinal support which is now in use for the treatment of Pott's disease. The ideal support does not exist, but there is one thing we should bear in mind, and that is, that Nature aims at fixation of the diseased articulation in Pott's disease as well as in hip-joint disease. The reflex muscular spasm is Nature's effort to produce immobilization, and the apparatus we apply simply emphasizes this effort. We cannot mechanically separate the diseased vertebræ by any apparatus, or by manual traction, or by suspension. All that we can do is to produce a more or less perfect immobilization. The intrinsic spinal muscles are our best aids in this direction, next to our apparatus.

Ever since 1882, when I commenced my lectures in the University Medical College in New York City, I have taught that we must study the spine regionally both in treatment and diagnosis. In other words, that we have in different parts of the spine distinct symptoms and distinct indications for treatment. The regional division is as follows: First. All the vertebræ from the occiput to the articulation between the third and fourth cervi-

cal vertebræ. Second. All the vertebræ between the last-named articulation and that between the seventh cervical and the first dorsal. Third. From and including the first dorsal vertebra to the articulation between the tenth and eleventh dorsal. Fourth. All the remaining vertebræ down to the articulation between the last lumbar vertebra and the sacrum. I also make some further subdivisions, but these need not be mentioned on the present occasion. In all of these regions except the third we can apply an apparatus that produces almost a perfect and ideal support where we have a normal kyphosis to begin with. In addition to this, there is little or no antero-posterior mobility of the spine, and hence we cannot give the patient an acquired position in which traumatism is modified. Then we have the rib attachment, which further prevents any effort to secure, for example, a lordosis of the spine seen in disease of the fourth region, and which is so effectual in modifying traumatic contact of the diseased articular surfaces. Finally, we have the constant traumatism of respiration, which more than any other cause renders mechanical treatment inefficient in this peculiarly exposed third region.

I accept all that Dr. Lovett says as applied to this third region, but I do not think we can apply his remarks to the other regions, when, mechanically speaking, we can apply a support that does actually protect.

In my little work on *Pott's Disease*, written in 1878, I made and reported some experiments bearing on some of the points Dr. Lovett mentions. I do not know how many experiments I have made on that point, but I demonstrated then that the true pathological curve is not modified by suspension. I have had cases where the patient felt something give way, followed by fainting after suspension, and I have no doubt that the effect of the suspension was to break up and separate adhesions which had occurred between the vertebræ. In Pott's disease I aim at recession of the kyphosis, if possible. Still, I believe we should always be content to succeed, in active disease, in maintaining the kyphosis at the point in which we commenced treatment. I do not think it is necessary to suspend any patient in Pott's disease. I put the patient in a prone position, and let him lie there for a few moments; and thus I aim to put the parts in the required position by re-

cumbency. This does not disturb the parts by making unnecessary traumatism. I have known several narrow escapes from the effects of suspension, and I think we can modify the normal curve in applying the safer and more rational principles of recumbency, making manual traction, if necessary, before applying apparatus.

Dr. A. M. Phelps. In 1884 I spent some time in the general hospitals of Hamburg. I was there one year (the Children's Hospital), and there were something like thirty cases of Pott's disease of the spine in that hospital. They followed the plan of treatment advocated by the Germans up to that time—that is, to put the patient to bed and keep him there until cured. These patients had been in bed for months, and some for years. With an assistant, we proceeded to empty those beds by applying plaster-of-Paris corsets, and the results of that treatment were published in 1885. We took these patients and applied the principle of treatment laid down by Dr. Sayre, which I believe to be entirely correct, and that is, to suspend the patient at the point of comfort; when he is in that position fix him with anything you like. The plan of putting patients in bed is an old one. It is all right to put a patient in bed for a few days, but to keep him there for a long time is not, in my opinion, the best plan. If an abscess forms while the patient is in bed, it is bound to burrow and discharge through the bodies of the vertebræ. If the patient is in an erect position, the pus will find exit from the body. You talk of patients improving in flesh and body; that has not been my observation in these cases, and I have seen a large number of them.

In regard to what we shall do, of course we all agree that to immobilize perfectly the spine and relieve pressure is the fundamental law of treatment. It is correct; it is right. Dr. Taylor believed that he could immobilize the spine and relieve pressure by bending it backward, applying antero-posterior support, throwing the weight of the body on the transverse and articular processes. So far as it goes, there is a principle in it also. But suppose the spine is curved laterally a little, and then you bend it. What do you do? You increase pressure and increase the distortion of bone, as well as the kyphosis in the dorsal region. Where Taylor's brace is applied such cases go on from bad to

worse as regards deformity. One other reason why such braces should be discarded is that in the large percentage of cases there is a lateral curve with Pott's disease. Bend the spine and you increase the deformity by increasing the pressure, and the kyphosis will increase. Another reason why these deformities increase is because you put on a brace that will permit the mother of the child or the nurse to monkey with it. It is not under your eye. The patient complains of pain somewhere, you take it off yourself, and then the mother thinks she must take it off also or loosen it in some way, and the result is in these cases the kyphosis increases. Take the patient from the hands of the mother, apply a support that you think will relieve the inter-articular pressure; you immobilize the spine with a permanent support, and, it seems to me, that there is no single brace that will do that perfectly. One must, therefore, take the patient entirely out of the hands of the nurse or mother and apply a plaster-of-Paris corset, and then the patient will be in a position of suspension. It fixes the spine in the position you desire it; the brace is worn for months and years and the patient is relieved. You tell me it does not support. These patients come to my clinics by the score, and I put on a plaster corset when they come in suffering pain, and they are immediately relieved.

Speaking of putting patients to bed, when a child is under three years of age it is impossible to apply any support to its spine. Such patients should be put into a frame like that of Dr. Steele's, or the wire cuirass of Sayre, or the plaster of-Paris portable bed. After the child has passed the age of three years then we apply the plaster-of-Paris corset. This is the plan we have been following in the Post-Graduate School in New York, and I believe it is the right one. Any brace which does not take from the nurse or mother the power of removal is not all-sufficient.

Dr. Reginald H. Sayre. I would like to mention in regard to the occurrence of Pott's disease in quadrupeds that the celebrated Harry Hill used to drive quite a fast horse which evidently had had some disease of the vertebra. His back was arched in the middle like a camel. There was more or less kyphosis, and his hind-legs and fore-legs were close together and very much re-

sembled a Pott's case walking on all fours. Lying on the back produces elongation of the body normally. This was stated many years ago, and was afterward controverted and the statement made that recumbency does not cause elongation of the intervertebral disks. But in some cases, recently measured, I find former observers were perfectly correct in stating that normally people are taller in the morning than at night. Recumbency in bed is hardly sufficient to prevent deformity in Pott's disease, or in disease of the knee-, hip-, or ankle-joint. We need to do something more to protect these joints from traumatism and to help Nature in her muscular splinting. Dr. Shaffer says nature uses the muscles to splint this inflamed bone, and until we put the bones in such a condition that Nature is not obliged to use the muscles to splint them, we have not put them in the best condition for recovery. In the case of the hip- or knee-joint we find the muscles are relaxed when our protection is efficient, otherwise these muscles are in a state of spasm. The same thing exists in the muscles of the back, and when these muscles are free from that state of spasm and the joints protected by our appliance, so that Nature can relax the muscles, that joint is in a position to recover more quickly than under other circumstances. I therefore think that traction with recumbency is one of the best means in the treatment of these cases. I think there is no doubt that many cases cannot be treated in an ambulatory manner, but should be treated in bed, and if they are to be treated in a recumbent position I prefer a portable bed, such as a cuirass, so that the child can be taken in the outer air, rather than a stationary bed. In a paper which I read in Washington some years ago I stated that in all cases above the middle dorsal vertebra the use of the plaster jacket should be supplemented by the jury-mast, to take the weight of the head and shoulders from the inflamed joint. Where the disease is in the upper dorsal vertebra the jacket affords an inefficient means of protection unless supplemented by something else, such as Dr. Whitman's apparatus to hold the shoulders back.

In regard to ambulatory treatment in adults, I remember one patient who had been advised that he could not recover without spending a couple of years in bed, and the question presented itself to the man as to how he was going to support his

family while lying in bed for years waiting for his spine to recover. Under treatment with a plaster-of-Paris jacket he was able to attend to his business and to support his family without an increase in deformity.

Dr. Phelps made a remark with reference to the patient being suspended at the point of comfort. I read recently several articles advocating hammock-suspension on the ground that vertical suspension causes such great agony and screaming of the patient, particularly in the case of small children, that it was impossible to apply a jacket well in that position. I simply wish to say that if such pain and agony were caused to the child, the jacket was improperly applied. There are certain cases where I think horizontal suspension is better than vertical, as in cases of excessively feeble heart. There are patients who will not endure the vertical position without fainting. There are a few cases where the spine can be put in a position of more comfort horizontally than vertically, and I have also seen jackets put on in the vertical position which did not come sufficiently close to the hollow spine and did not give proper support. If you wish to experiment with a jacket to see whether it will hold the patient's weight or not, the weigh ought not to be borne upon the jacket until the plaster has set.

Dr. Royal Whitman. Speaking of this demonstration, I should protest against its literal application that seems to have been accepted here, because the conditions in the living subject are quite different. We know that Nature always accommodates other portions of the spine to the deformity. This demonstration may illustrate an argument, but it does not point out to us the true mechanical conditions which concern us in the treatment of Pott's disease. There is no such depression of the head as illustrated by the ten pounds of weight applied here, and no such leverage at the seat of disease. In regard to the counter-pressure on the thorax, I would suggest that Sayre's plaster jacket seems to carry out the idea of a solid, rigid support which has been emphasized by the reader. In this connection I would again call attention to the principle of backward traction on the shoulders. The apparatus that I have suggested for this purpose involves two principles, one to throw the shoulders backward, and thus to provide better fixa-

tion at the seat of disease and at the same time to elevate and expand the thorax, and to prevent movements of the arms that increase the normal kyphosis. I think the second principle is as important as the first.

Dr. S. L. McCurdy. I desire to emphasize the position taken by Dr. Whitman that the apparatus appears to me to be incorrect as shown here. As constructed, it shows the supporting power of that part of the body where the cut is made from the apparatus as being almost on a line with the posterior surface of the apparatus. We find the supporting power of this splint afforded to portions of the body above the dorso-lumbar junction. For instance, the weight is thrown at least two inches and a half anterior to the furthest point back of the spinous processes and above and below. If Dr. Lovett desires to make an accurate demonstration, it appears to me the blocks should be pushed further forward before he attempts to make an accurate calculation as to the amount of the weight above by the support below.

Dr. John Ridlon. Dr. Lovett has demonstrated to us what this apparatus is capable of doing, but I think much of the discussion has arisen from the fact that we have been discussing conditions that we have seen in individuals. I had always supposed that a case of Pott's disease of four years' standing was beyond straightening by any form of treatment, and I think that has been generally accepted. Nevertheless a year ago, a child, aged eleven years, with Pott's disease of the spine was brought to me, the disease being of four years' duration. There was very great kyphosis of the ninth and tenth dorsal vertebræ, and there was a psoas abscess. For the sake of treating this abscess I put the patient in bed, and anchored her by applying a two-pound weight to the head. I did not apply traction to the legs. At the end of six months the spine had elongated an inch, and the curve I had taken at the time she went to bed was distant, at the point of kyphosis, an inch and three-quarters from the old one. I mention this as an argument supporting Dr. Lovett's advocacy of treatment by recumbency, even in cases where we suppose recumbency is unnecessary, so far as any straightening of the spine is concerned.

Again, I had always been taught that in the treatment of Pott's disease at the first, second, and third dorsal vertebræ by the antero-posterior Taylor brace and chin-piece, that the deformity would not increase; that in almost all instances we must expect an increase of deformity in this position when treated by this brace in this way. Nevertheless I have had during the past year a case where the deformity had not only not increased, but had disappeared. In such a case, it is perhaps a matter of good luck, not good treatment. We should treat the cases on the line advocated by Dr. Lovett, namely, by recumbency and traction. Here was a case where that treatment was wonderfully successful; but we must not argue from it that all cases can be successfully treated in that way. I am fully in sympathy with what Dr. Lovett has said, and agree with him that it is the proper way of treating these cases.

EFFECT OF POSTURE ON THE SPINE IN THE APPLICATION OF PLASTER JACKETS.

By E. G. BRACKETT, M.D.,
BOSTON.

It is intended in the presentation of this subject to consider a few of the practical points in the employment of the jacket-form of support, a few of the indications which influence the methods in its use, and the objects which may be hoped to be accomplished. It is necessary to have in mind the relation which these or any such experiments may have to the clinical side of the question, for it is certainly true that the results of purely mechanical experiments or observations cannot be directly applied to clinical practice, as the conditions governing each are widely different. The ideal in experimentation is by no means difficult to obtain, but its application in clinical experience is often possible to a limited degree only, and the true test of value of such can be determined by practice alone.

The matter of choice in the treatment of spinal caries by an antero-posterior or a corset support has had many firm advocates, and unfortunately the warfare has been carried on within narrow lines. If one consults the literature on the subject, he is struck by the meagre detail which is given for its exclusive use, in many instances narrowing down to individual preference, and frequently the ground is held by claiming the want of skill on the part of the opponent in his ability properly to apply the support in question. If one looks further for the rules for the application of one or the other forms of support, he unfortunately has but little reward. Some claim that the jacket is efficient as a means of securing fixation in an improved position, and others claim that it is applicable only during the convalescent stage or the stage of consolidation. On the other hand, the advocates of the jacket claim that it should

be used during the active stage, and whenever there is desired the greatest amount of fixation. Other indefinite rules are applied, but one must pursue further than it has been the writer's opportunity of late to find any theoretical reasons based upon experimental research which would lead one to formulate rules by which he may be guided in the intelligent choice between one or the other means of support and in the method of its application, or why one should be far in advance of another, either for selected cases or for general use.

In the present consideration of this matter we must, at least in a measure, draw a comparison between the relative value of the brace and the corset-form of support, but not attempt a discussion of their relative value; and it would seem better to consider, first, the necessary requirements which are indicated in the treatment of spinal caries, and, second, in what way and measure these are met.

In all methods of treatment there are definite objects which we aim to attain without reference to the means employed, and which must vary according to the individual case and the stage in which the treatment is applied; but in general it can be considered as fixation, the avoidance of jar, and the removal of pressure between the portion of the structures which is diseased.

In many conditions, and in certain stages, the treatment by recumbency is imperative; but in all cases there comes a time when ambulatory treatment is a necessity, and the problem is then to remove as far as possible the violence by jar and pressure on the diseased and yielding bone.

The question of the form of support is not so important as the manner in which it is applied, whether the antero-posterior in the form of a steel back-brace, or the corset-form, as the plaster jacket. It is manifestly unpractical to assume, in the face of so much clinical evidence, that this support can be accomplished by only one form of appliance or by one mechanical means, since it is often rather a matter of skill in mechanical adjustment which gives individual preference, and the comparative value of the two means of treatment will not be considered in this paper, but rather the positions in which we should place the spine, that it may be under the most favorable condition for repair.

The growth of the knuckle is the usual test of the success of the treatment, and the amount of deformity with the cure is the prac-

tical evidence of value of the treatment. During ambulatory treatment the main object is the removal of pressure on the bodies of the vertebræ, as in the stage when this treatment is safe mobility and jar are less harmful.

It must be remembered that the knuckle may increase either by destruction of bone, which causes a true growth of deformity, or with the exaggeration of the natural curves of the spine, by which the projection is thrown into greater relative prominence ; and this increase may continue after all active process has subsided, by the yielding to pressure of the growing bone held for a long time in one position, in the same way that bone-distortion occurs in long-standing cases of scoliosis. The most important of all in this stage is the removal of anterior intervertebral pressure in this part of the spinal column. In the earlier stages it is necessary to prevent irritation from pressure on bone still in the process of disease or cicatrization, and later from the absorption of bone even after complete healing, from the increase of pressure resulting from the position, further forward than normal, of that portion of the trunk above the knuckle. This condition is closely analogous to ordinary round shoulders, except that in the one the site of the strain is distributed rather uniformly over the whole of a normally flexible spine, and in the other it is concentrated at one point, particularly susceptible to pressure, and yielding to this pressure, at this point alone, as is seen by a marked growth of projection which may increase even a long time after all symptoms of activity of disease have passed. This removal of body vertebral pressure can then be accomplished only by placing the spine in such a position that the bodies have more room than in the ordinary natural curve. In the same way that in disease the force of gravity in the position taken by the patient tends to diminish this area, so in the treatment the opposite effect must be in some way accomplished. This can only be done by some change in the amount of the natural curves of the spinal column. As flexion causes a crowding together of all the bodies in the area of motion, so extension in the opposite way allows more room, and diminishes the amount of pressure on the bodies. The aim, therefore, must be so to place the spine that this backward curve in the area of disease will be increased.

It must be remembered that it is not sufficient simply to increase

the curve or to change the position of the spine above the point of disease alone, but that the position of the spine below determines quite as much the amount of pressure as that of the spine above, and the position in which the patient is placed must therefore be such that both portions of the spine, above and below the point of disease, are affected.

Suspension can have no effect on the separation of the bodies except by producing a backward extension; since the axis of the motion is posterior to the bodies, and actual distraction does not occur, suspension obliterates the forward curve in some regions, but in others it will tend to increase, and it can be seen from this that, so far as suspension alone is concerned, it is not the ideal method which is applicable to all regions of the spine.

Although it is impossible to hold the spine in the position in which it may be placed, and therefore the treatment can in no way be as ideal as the experiment, yet we can place the patient in as nearly as possible an ideal position, and maintain this to a greater or less degree. The difference between the position of the spine before and after the jacket is applied by the different methods does not materially vary, being within the range of the ordinary limits of error of application of spinal support; but the nearer we start with the spine in the desired position, the nearer we may hope this to be maintained. The experiments are to show in what position we may expect to place the spine in the conditions most favorable for the removal in the greatest degree of the pressure on the vertebral bodies.

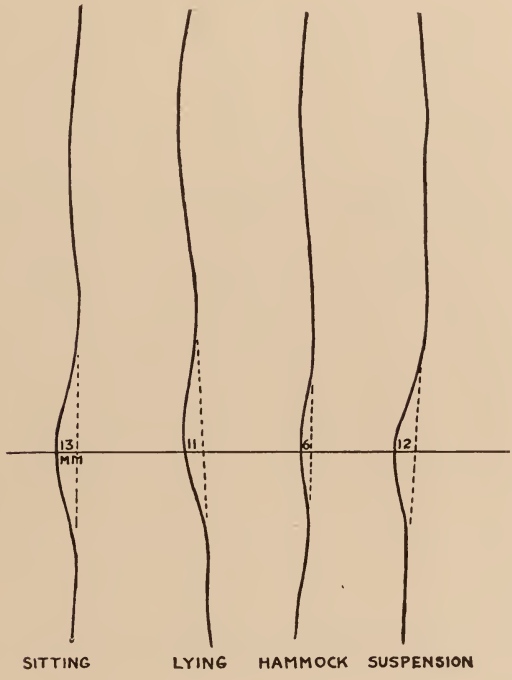
If then we aim to place the spine in that position in which the bodies shall be allowed more space, our methods must vary to a certain extent with the region diseased, since we are dealing with a spinal column having different curves, and in which the same force, acting in the same way, will not produce like effects in the various regions. We have, therefore, to consider the effect produced by the various postures, and by what methods we can place a spine in a position nearest to that most desired to be maintained.

A study of this has been made by placing the subjects in the positions of sitting, lying on a flat surface, lying on the hammock frame, and suspension, and the results obtained will be most briefly seen by reference to the diagrams of curves, which are given as

examples, and which have been verified by several experiments for the results obtained in each.

Fig. 1 shows the results of the four positions in a case of lumbar caries, in which a knuckle pronounced for this region existed. First of all, it is seen that the knuckle of itself varies in its prominence, as is shown by the relative inclination of the spine, both above and below the site of the disease, and this determines the

Fig. 1.



amount of space given the anterior portion of the column. This is shown diagrammatically by the depth of the curve as traced in the intersecting lines. The sitting position may be taken as representing that in which the spine is placed in that most favorable for pressure on the bodies, and in which the least space is afforded for them. In lying on a flat surface the curve above is diminished, but slight change below is made, so that but little more space is

provided. In the position of lying on the hammock, which in this instance was allowed to sag slightly, the curve is decidedly diminished both above and below, and the amount of curve reaches the minimum. In suspension the curve below the prominence is much lessened, but above is so increased, even over that of the sitting position, that the amount of prominence remains the same as that in the first position, when no attempt is made to produce the correction of the attitude.

Fig. 2.

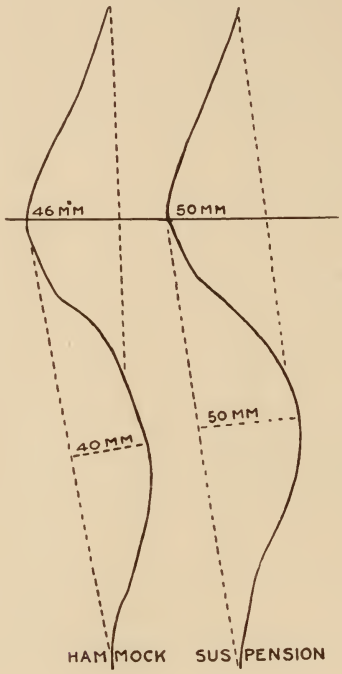
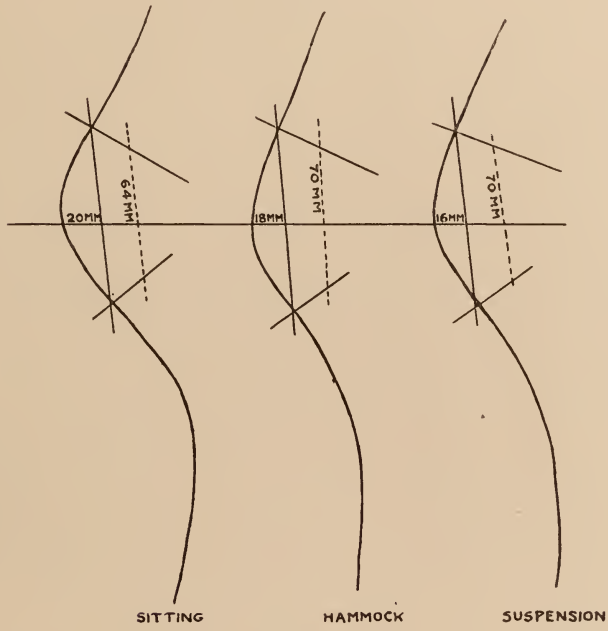


Fig. 2 compares the tracings of a case of mid-dorsal caries in the positions of lying on the hammock and suspension. The intersecting line is taken in front from points at the same level on the spine above and below the mid-point of prominence, and shows a difference of 4 mm. in favor of the recumbent posture. It will be seen that the relative angle above the disease is essentially the same in both, but that the forward curve of the spine below is much greater

in the suspension, as is shown by the depth of the cavity, being 10 mm. in favor of the hammock position. Although the forward bending of the portion above is equally corrected in each, the increase of the curve below in the suspension position results in the greater crowding together of the bodies.

Fig. 3. The condition found as shown in Fig. 2 is apparently the usual one, but is not always so pronounced, and it would not be fair to give this alone as an example of the relative curves in

Fig. 3.



these positions. In Fig. 3 are shown tracings from a case of disease in the same locality, but one which presented less active symptoms. The first tracing may be taken as showing the most vicious position, and in which the bodies are receiving the greatest amount of pressure. In the two corrected positions it is seen but little difference exists, this difference, however, being in favor of the hammock-frame ; looking at the angle of the curve above the knuckle, it will be seen that both are equally corrected, and that this slight difference is made by the greater forward curve in the portion below

in suspension. This greater curve would, of course, not cause greater intervertebral pressure, providing the portion above was over-corrected in a like proportion; but without this increase it must result in diminution of the space afforded to this part of the spinal column.

The following conclusions may be drawn:

The removal of weight from the vertebral bodies is accomplished only by such means as bring about a backward flexion of the spine, which produces to a greater or less extent a separation at the point of bending.

This amount of relief of weight is influenced by the relative curve of the spine below, as well as above the site of prominence.

In the positions which tend to produce backward flexion a distinct diminution in prominence of the knuckle may occur.

The hammock method allows the placing of the spine in cases of mid-dorsal disease and below in the most favored position for the removal of body-pressure.

Frequently, in the suspension-position, one portion of the curve is not diminished, and in some cases is slightly exaggerated.

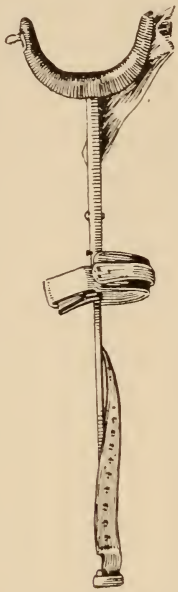
EXHIBITION OF SPECIMENS.

Dr. Joel E. Goldthwait. It will take me but a minute or two to show these specimens. Here is a specimen of a spine from a child who had lumbar caries. The child died of general tuberculosis. The location of the disease is plainly shown. There was an old psoas abscess on the left side which had closed some time before death. A short time before the child's death acute symptoms developed on the right side and a small abscess could be felt in the right groin. The child's condition was poor. No operation was deemed advisable until one morning, when the patient was suffering, it seemed wise to make a complete opening. That night the acute pain subsided and the old sinus commenced to discharge. The interesting feature about the specimen is that at the autopsy it was found that the abscess had its origin well behind, and the point of communication of the abscess was directly through the bodies.

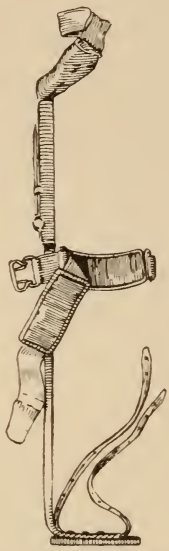
The other specimen seems to me quite unique. This is a section of the spine from a patient who died from malignant disease. The interesting feature is that at the time of the autopsy, in looking at the spine from the front, the body being opened by median incision, nothing abnormal was noticed with the exception of this depression, which you see. The spine was taken out, a section made, and the interesting feature is that the bony tissue is almost entirely replaced by cancerous tissue, and the microscopical examination shows carcinoma. The majority of the tissue is cancerous, the intervertebral substance not being affected at all. This point here of the vertebræ has been entirely changed, and the weight of the body squeezed it down or pushed it back, making transverse pressure and causing paraplegia. The cord is not involved.

Dr. V. P. Gibney. I desire to show a splint which I think is pertinent to the subject of knee-joint troubles. For a long time I

have been at a loss to make my patients comfortable in wearing a Thomas knee-splint, and we all appreciate the difficulty of getting the ring properly adjusted so that they can sit down. The objection to the use of the splint is that where you want to use a spinal brace or jacket it wears off the plaster, and furthermore it seems to me unnecessary to have two bars. So I had just this arrangement made with a crutch-piece. Then came the question as



Traction knee-splint, showing perineal crutch.



Traction knee-splint with perineal crutch. Front view.

to how we should get pressure above and over the knee, and keep the limb in position. I made traction on the leg, and with a steel band above the joint I was enabled to make a fair amount of pressure over the knee just above the patella, which is a good place for it. This thigh strap is unnecessary. The splint speaks for itself. I have tried it in a half-dozen cases, and with it I can hold the limb in good position. The splint is not at all ungainly looking.

On motion of Dr. A. E. Hoadley, seconded by Dr. Edmund Andrews, the order of business was suspended in order to give

Dr. John D. Skeer, of Chicago, an opportunity to present to the Association a new surgical saw which he had devised for the purpose of improving the technique of Fenwick's operation for excision of the knee-joint. The saw-blade is nine inches long, two inches broad, curved on the flat with a concavity of one-fourth of an inch, and it cuts a true circle, so that when the concave surface of the tibia and the convex surface of the femur are brought together they will coaptate with mathematical accuracy. Dr. Skeer said that it is surprising to find how easily this saw can be adjusted to the proper angle. He exhibited a segment of a circle cut with the saw, which could be placed at a right-angle to the long axis of the bone and used as a guide; after cutting down an inch or less the saw takes care of itself, provided one is careful to keep it close to the end of the bones.

SPINE-BRACE.

By A. E. HOADLEY, M.D.,
CHICAGO.

The brace that I wish to describe and exhibit is one that I have designed and adopted for the mechanical support of the middle region of the spine, the range of its greatest utility being the support of the spinal column between the middle of the lumbar and the middle of the dorsal regions, although its usefulness is not strictly confined to these limits. Inasmuch as the greater number of diseases of the spinal column requiring mechanical fixation occur within this region, its usefulness will be comparatively very great if found to be an efficient brace.

In its simplest form the brace consists of a steel frame, a rigid chest-pad, and two aprons. The chest-pad is adjusted in contour to fit the upper anterior portion of the chest. The pad should be in length about three times its width, and adjusted transversely, resting immediately below the sterno-clavicular articulations. Its real length transversely should be as long as practical without being interfered with by the action of the pectoralis major muscles in the movement of the shoulder. It should be made of sheet metal hammered to give shape and rigidity, covered, and lightly padded.

The frame consists of one piece of round-rod steel, from three-sixteenths to five-sixteenths of an inch in diameter, so shaped that it crosses the body above and below and lies parallel with and in close proximity to each side on a line with the axilla; the ends are welded or brazed where they meet, making it one continuous piece. To facilitate the description of the frame we will divide it into four portions—an upper, a lower, and two lateral portions. The upper and lower cross in front of the chest and pelvis respectively, and no portion of the frame passes behind the body. The upper portion

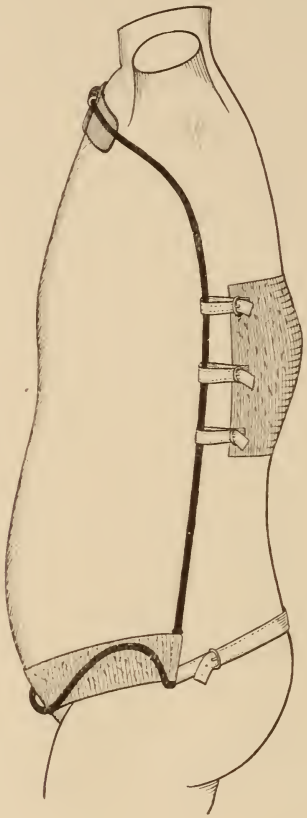
of the frame arches upward and forward from a short distance below the axillary space on one side, crosses the chest-pad and then downward and backward to a corresponding point on the opposite side, where it becomes continuous with the lateral portions. There is no fixed point or angle to indicate where the upper and lateral portions come together—a gentle reverse-curve marks the place. The lateral portions are so adjusted as to lie close to the sides, a little nearer the posterior than the anterior aspects, and extend from below the axilla to the space just behind the anterior superior spine of the ilium below the crest and above the trochanter major. In children these portions are practically straight, while in adult females they bend in at the waist-line and then arch out over the more or less prominent hips, but remain straight in the antero-posterior directions, unless some deformity requires a change in this shape.

The lower portion is simply to connect the two lateral portions across the body at their lower ends and hold them rigid relative to each other. In the adjustment of this portion, however, there are some difficulties: for if we extend it straight across from the lower end of one lateral portion to the other, it would prevent the flexion of the thighs; and then again, if we arch it up over the thighs, it would cross the body above the umbilicus and very materially interfere with the clothing at the waist. And to cross behind the body would be still more objectionable, as the patient would then have to lie upon it, and it would be more difficult to put it on and take it off; so it must take a somewhat tortuous course and cross in front by avoiding those places where its presence would be objectionable. This is accomplished by having the lower portion turn sharply upon the lateral portion, which it is to follow a short distance, and then arch in over the flexed thigh, and then depress it to, or very near, the pubis, to some extent following the fold of the groin in the direction of Poupart's ligament, and as close as possible, having in mind that when the finished brace is applied that no part of the frame touches the body, but lies very close to it at all points.

The upper portion of the frame rests by its central portion upon the centre of the chest-pad, to which it is secured by a double-acting joint, so that the pad may adjust itself to the chest.

The lower portion of the frame is prevented from touching the body, and given a fixed point by an apron made of two thicknesses

of canvas from two to four inches wide, according to size of brace, between the layers of which a few whalebones have been inserted vertically to prevent rolling. The apron is secured to the lower extremities of the lateral portions of the frame by its ends, and at such an angle that its direction from its attachment toward the centre shall be downward, or, in other words, the upper margin of



the apron at its attachment shall be the longer one, otherwise the tendency will be for the apron to slide up across the centre of the abdomen. This apron should be just long enough to keep the lower part of the frame from touching the body. If properly adjusted, it will pass across the lower part of the abdomen very close to the pubis, and upon each side will include and remain below the ante-

rior superior iliac spines which constitute the lower fixed point for the frame.

To complete the brace of simple form it is only necessary to attach the second apron or back-band. This second apron, which is to extend from one lateral portion of the frame across the back to the other, is to be also of double thickness made in shape to fit any angular deformity. It should be from three to six inches wide, without whalebones. One end is to be permanently fastened to one lateral portion of the frame, at a position opposite that portion of the spine to be supported ; the other end is to be provided with two or three straps with buckles with which to buckle it to the opposite lateral portion of the frame.

Thus completed we have a spine-brace of the simplest possible construction, the smallest amount of material, and at the same time providing for the fixation of the three points relative to each other in a most positive and efficient manner. The upper front part of the chest, the pelvic bones below, and the weaker portion of the spine behind are retained in relative position to each other with positive certainty. Positive, because these are parts of the framework of the body that have a certain relative stability to each other, and between which all of the deformities in caries of the spine in this region occur. These are the points and the only points where definite and reliable resistance to deformity can with certainty be applied and maintained.

In regard to the mechanical adaptability of the different parts to the purpose for which they were designed I shall speak separately.

The frame as just described is identical with the first one that I made three years ago. While I have experimented considerably I have not in any respect changed the design originally made for the plain brace. All that I can say of it is favorable ; there are comparatively no objectionable features, while there are a few that are highly commendatory. It is very light, strong, rigid, simple of construction, easily changed in shape, composed of one piece, and it is as much out of the way as it is possible to have anything that can claim the name of spine-brace. It can be readily constructed by any common blacksmith at the cross-roads, which is no small consideration from an economical point of view.

The small canvas apron that crosses the pelvis shrinks and moulds

itself over and around the anterior spines, so that a most satisfactory support for the lower end of the brace is secured capable of resisting any force that may be required either continuous or intermittent, and without producing excóriations or large callosities. The difference between the plump or fat abdomen in the adjustment of the lower fixation is of no importance; even with the very fat there is less to contend with this than with any other of the forms of lower fixation with which I am acquainted. This small apron, so called, which is little more than a strap is all that can be required and comparatively speaking, it is "multum in parvo."

It is now about six years since I adopted the chest-pad to support the upper part of the column. Why it had not been used, fairly and squarely before, I did not know. I could neither find that it had been used simply and alone, nor any reason why it had not been. To me it seemed perfectly feasible and, from an anatomical standpoint, eminently proper. I therefore determined to try it and, if possible, find out why it was that, in all corrective and retentive appliances for Pott's disease, this particular region, the centre and upper part of the chest, was universally avoided. I commenced by using a small pad to which I secured the upper ends of the parallel uprights that support the back pads of the common form of brace. I found that the small pad was sufficient and comfortable, and, as far as I could observe, there were no ill effects from its use. Consequently, when I came to design the present brace the chest-pad was no experiment. It had already, in my hands, proven to be efficient and satisfactory. I have now used it on this brace for nearly three years and in a great variety of conditions and cases, old and young; and in no single instance have I been able to observe the slightest deleterious consequences. There is no complaint whatever and no local changes to be seen. I am, therefore, most emphatically of the opinion that the proper place to secure and adjust the upper anterior fixation in spine-braces is the upper part of the chest when the disease is low enough to permit. I do not believe that there is any tendency to flatten or distort the contour of the chest; even the active rhachitic patient tolerates this pressure without the slightest local change. Neither is there the slightest impediment to respiration. Relatively the chest is the proper place, as suitable leverage can be obtained there, and anatomically it is

rigid, and the effect of counter-pressure is direct and reliable through the bony framework to the diseased portion, and entirely independent of any muscular action whatever; and clinical experience thus far shows that any required degree of pressure is tolerated with comfort, leaving perfect freedom of movement to the shoulders, a condition of things quite unusual in spine-braces.

The back-band that crosses the back at the seat of the disease from one lateral portion of the frame to the other furnishes, in my opinion, the best possible retentive force. The distribution of pressure over a large surface is an advantage. It is tolerated with perfect comfort. It does not induce pressure-atrophy or excoriate. Pressing, as it does, firmly upon the angles of the ribs, as well as upon the spines, its influence to prevent or correct rotation or lateral deviation is far more than would at first sight be appreciated, and, when combined with some of the accessories which are to be described, this particular resistance to rotation and lateral curve or deviation becomes most effectual. The firm, unyielding character of the support, and the great degree of force in the direction of correction that can with comfort be tolerated, is surprising. With a firm adjustment of this brace, bringing proper tension upon the gently curving chest-pad, and bringing the pelvic strap or apron securely against the iliac spines, and with the firm application of the back-band to the full width of the back, exerting pressure upon the ribs as well as the spines, there is no tendency whatever, in the average cases, for any body-movements to take place, such as the rotation of the upper part upon the lower, or deviating to one side or the other. The support is practically perfect, maintaining equal poise, and suspending all voluntary effort to sustain equilibrium and the erect attitude. The foregoing description of the brace, together with the description of its applicability, refers only to the brace in its simplest form and to diseased conditions of average severity with but moderate deformity. The brace, however, is susceptible of many modifications and the addition of many accessories, to meet the requirements of varying diseases and deformities without losing the original principles of construction. The most simple modification which changes the shape of the frame is the substitution of a pad over the pubis and lower end of the rectus muscle, similar in construction to the chest-pad, to take the place of the canvas apron at that point. The

frame is then changed so that the side portions, just above the crest of the ilium, turn forward and inward to follow nearly the fold of the groin and to meet in the centre over the pubic pad, to which it is attached by means of a joint that will permit of a racking motion only; two staples, an inch or two apart, answer very well. This modification of the frame does away with that portion that passes down to the space above the great trochanter. This simple form is all that can be desired as a convalescent brace. It is light, easy, inexpensive, and very efficient, and the pubis and tissues immediately above it tolerate the pad-pressure remarkably well.

When it is desirable to fit this brace to a patient who has a tendency to a lateral inclination it should be provided with three pads, one above and below on the concave side, and the other in the middle on the convex side. The one below should be round and hung loosely on the lower end of the frame so as to rest in and adjust itself to the space described above the great trochanter. The upper pad should rest just as close to the axilla as practical, the frame to be modified so as to support it. It may be arranged transverse or vertical. I usually use at this point long or oblong pads. The middle pad should be long and attached, with its long axis vertical, to the lateral portion of the frame at the place where the pressure is to be exerted.

As much retentive and corrective force may be applied in this way as the patient can tolerate. Where great need exists for lateral retentive force it is advisable to add crutches to the brace. The crutches can be made part of the frame and adjusted from below by raising or lowering the entire frame, which can be done within short limits or, which is better, have the crutches supported by a separate piece made adjustable upon the lateral portion of the frame. Where this latter method is adopted, it is necessary to have the back-band secured by straps and buckles upon each side. Where the crutches are added it is only necessary to attach a supporting-band at the lower end of the frame to carry the crutches and their superimposed weight. A strong webbing strap buckled across the lower part of the back or sacrum, from the lower extremity of one lateral portion of the frame to the other, answers this purpose exceedingly well. Any required degree of support is easy to bear and is un-

yielding. It is by far the best crutch-support with which I am acquainted.

Taken together with the little pelvic apron that crosses in front, it embodies the principle, which is in the support, adopted by the color-bearer in carrying the heavy pole and flag. Pads at the lower extremities of the lateral portions of the frame are advisable where the supporting-strap is applied, although not strictly necessary where the frame is well made and rigid.

Where there is much compensatory lordosis, protrusion of the lower ribs, or a very prominent abdomen, an apron of proper dimensions should be strapped across the front of the abdomen at the place required and with the required tension. Occasionally it is desirable to include the whole front of the body in such an apron.

In some cases, where the body is thin and the spines prominent at the seat of the disease and deformity, it is advisable to provide the back-band with two pads, to rest one upon each side of the spine. These pads should be secured to the back-band, made wide enough to extend from the spines of the vertebræ to the angle of the ribs and as long as the band is wide. They should be made as hard and as smooth as practical by stuffing them with cotton or wool, or make them primarily of folded blanket.

To make the frame for any given case it is always advisable first to make a form of soft wire; soft iron or copper wire of a size that can be readily bent with the fingers should be selected. The patient should be placed lying on the back, with the body in the position in which it is to be retained, and the wire bent to fit the body just as the finished frame should fit. It is best to adjust the wire across the lower part of the body first, and the ends will then lap across the top of the chest, where the lapped ends are to be secured by winding them around each other or winding them with a string; the former is the best plan. This wire frame, which can be made exact in shape, furnishes the artisan perfect lines for the construction of the finished steel brace.

REPORT OF FOUR CASES OF SPONDYLITIS OF THE SECOND CERVICAL VERTEBRA.

By REGINALD H. SAYRE, M.D.,
NEW YORK.

Three years ago I brought before this Association some cases of spondylitis of the second cervical vertebra, as it happened that within a few months' time four cases came under my observation which presented almost identical lesions, accompanied by very similar deformities. These cases have now been without apparatus to support the head for a number of months, and I therefore bring them once more to your attention. In all of these cases there was noted a small swelling at the back of the neck, at the level of the first or second cervical vertebra, which swelling, in each instance, happened to be on the right side of the neck. In each case the chin was directed toward the right side of the body, the right sterno-cleido-mastoid muscle was rigid, the face looked downward, while the left ear was brought much nearer the corresponding shoulder than its fellow. In one instance the face was deflected so far from the perpendicular as to be almost parallel with the floor, and pressed so closely against the clavicle as to cause an excoriation. The position of the head was in marked contrast to that assumed by patients with torticollis, due to contracton of the right sterno-cleido-mastoid muscle, as I pointed out in my first paper. Motions of the head in any direction were excessively painful—rotation more so than the others, and the patients supported their heads with their hands almost incessantly. In turning to view any object the entire body moved as a solid mass, without any rotation of the head. The jaw was opened with great difficulty in all cases, and in two in which I suspected the possibility of a post-pharyngeal abscess I was hardly able to pass my finger far enough into the throat to clear up the

diagnosis, and in one case it was impossible to do so. At the present time, all but one can open their mouths freely, and this one case has much more control of his mouth than formerly, and is enabled to swallow with much more ease. In all the cases the chin was so much depressed as to make swallowing difficult. These cases were treated by means of a support which consisted of a pelvis-belt with two upright back-bars passing upward over the shoulders, and held in position by shoulder-straps and an apron. From this, as a base of support, an extension-rod passed from between the shoulders to the base of the skull, where it joined a metal band which passed around the head, and was secured in position by a forehead-strap and a strap passing under the jaw from ear to ear. Universal joints at the back of the neck and between the shoulder-blades allowed the adjustment of this apparatus to any position of the head, while the distance between the head and body pieces was regulated by a ratchet and key extension. While the apparatus was being constructed I applied, in three instances, a plaster-of-Paris helmet and jacket, as a temporary expedient to hold the head in a somewhat improved position, and guard the patient against danger of fracture of the odontoid or rupture of the check ligaments, which accidents, in a certain number of recorded cases, have caused instant death, under similar conditions. The plaster bandages in these cases passed completely around the neck and joined the head-piece to the body-portion. The apparatus was applied to the patients, and the deformity rectified, as far as possible, without causing pain, and every few days the position of the head was brought still nearer to the normal until no further improvement in position could be obtained, without causing great pain. The anatomical relations of the first and second vertebræ do not indicate extension of the head on the trunk as one of the elements of treatment, and a very slightest amount of vertical extension only was required to give these patients ease; but the avoidance of rotary motion was necessary, in all cases, to give the patients a feeling of rest and security. It is also worth noting that the recumbent position caused more pain than the upright, which is not the case in disease in other parts of the spinal column. The explanation of this will be obvious on reflection—that while recumbent the weight of the head presses the body of the atlas against the odontoid process, whereas the erect

FIG. 1.

Fracture of odontoid in temporary plaster-of-Paris dressing.

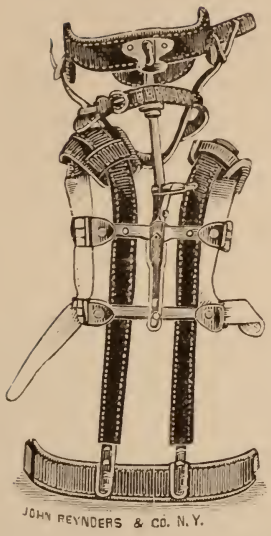
FIG. 2.

Fracture of odontoid. Rear view.

FIG. 3.

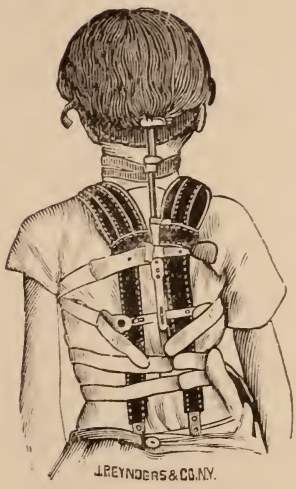
Lillie A. Showing deformity of second cervical spondylitis.

FIG 4.



Apparatus for second cervical spondylitis.

FIG. 5.



Lillie A. in apparatus.

FIG. 6.

Lillie A., cured. Second cervical vertebra spondylitis.

position or bending slightly forward relieves the odontoid from this pressure.

I, unfortunately, neglected to secure photographs of all of these patients at the time of my first interview, but have the photographs in two instances before treatment, and in three of the cases after treatment. The positions of the head in the two cases which I have not photographed are almost identical with those of J. T., which photograph I pass around. Three cases at the present time seem practically well, and since the removal of the support, some three months ago, the range of motion in the neck has increased in all directions, and there has been no return of pain. The remaining case has a very large amount of ankylosis of the cervical vertebra, and, in addition, has developed disease at numerous other points lower down in the spine, so that there is an almost complete rigidity of the entire spinal column. The deformity of the head seems to me typical of inflammation of the upper cervical region, and I saw this summer a case with precisely similar deformity, whose photograph I now pass around, in a little girl who, while swinging, was struck back of the neck by the rafters of the ceiling from which her swing was suspended. As she was swinging backward very high, a projecting rafter struck her just below the head, in the back part of the neck, and knocked her from the swing. She complained of intense pain, protected her head carefully in her hands, could bear no movement of it at all, had the same sense of impending danger and feeling as if she were about to die, if efforts were made to place her in the recumbent position, which were noticed in the case of Lillie A. Her legs also became very weak. She was put in a plaster helmet shortly after the injury, but the plaster, not having been made sufficiently firm in the neck, cracked and allowed her head to assume the deformity which is noticed in the photographs (see Figs. 1 and 2). She happened to be about the size of Lillie A., who had at that time abandoned her instrument, and the latter was applied to her and worn for seven weeks, at the end of which time she was perfectly free from pain, and could move her head in all directions, and appeared to be perfectly well.

My diagnosis, in this case, was a partial fracture of the odontoid process, with possible rupture of some of the spinal ligaments, the weakness in the child's legs apparently showing that there was a

certain amount of pressure produced on the cord. That disease of the odontoid may progress so far that the whole odontoid sloughs off and is removed from a post-pharyngeal abscess, without death necessarily following, is shown by a specimen I obtained from Dr. Bayard, of St. Johns, N. B., shown at the New York Pathological Society some years ago, in which this condition of affairs occurred, where sufficient ankylosis had apparently begun between other parts of the first and second vertebræ to preserve the solidity

FIG. 7.

Congenital torticollis.

FIG. 8.

Congenital torticollis.

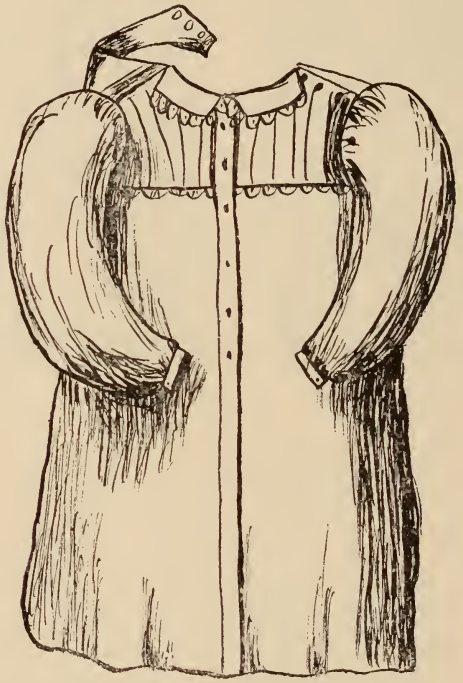
of the spinal column and prevent the head dropping forward simultaneously with the loss of the odontoid. That this accident, with the accompanying compression of the spinal cord and instant death, is of not infrequent occurrence, either from loss of the odontoid or sloughing of the check ligaments, literature on this subject fully proves. The similarity of attitude of these cases and the points of dissimilarity in the position from that of torticollis from neuro-muscular causes have seemed to me of sufficient interest to make it worth while to draw your attention to this subject for the second time.

A GARMENT FOR RECUMBENT PATIENTS.

By JOHN C. SCHAPPS, M.D.,
BROOKLYN, N. Y.

Among the practical difficulties that have contributed to prevent the general and thorough employment of recumbency in the treatment of Pott's disease are those of keeping smooth and clean the

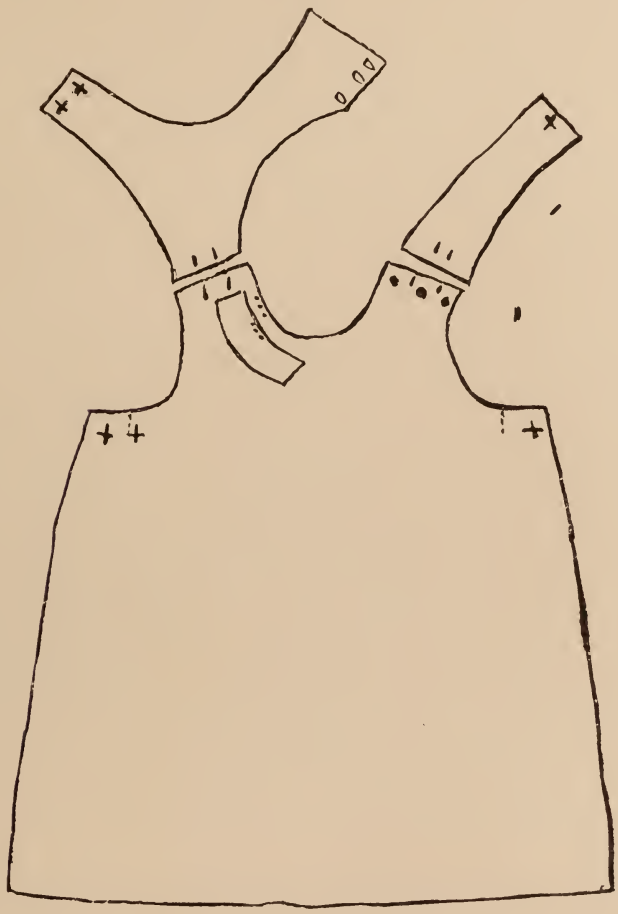
Fig. 1



surface upon which the patient lies, of having easy access to the back, and of changing the clothing without disturbing the spine.

All these conditions are essential to the comfortable and successful use of this method. The garment shown in Fig. 1, and which so far as I know is new in design, has been found useful not only for these cases, but it has also been adopted in one of the hospitals in

FIG. 2.



this city for the use of patients who are recumbent for any reason. It is especially convenient when a patient has a bedsore or incontinence of urine or feces. It differs from an ordinary nightdress in that there is no back, the front is broad, and the yoke is made

narrow behind and buttons on the shoulder. The pattern is shown in Fig. 2. In putting it on, the yoke is slipped under the neck and the front is tucked in or pinned like any other cover. It may, of course, be made with legs.

With the patient so clothed a very slight rolling will give easy and ample access to the back. In Pott's disease the turning should be accomplished in this way: Two persons are necessary; one stands at the head and takes hold under the shoulders, grasping the head by means of the forearms. The other takes the pelvis and thighs. It having been clearly indicated which way the patient is to be rolled, both grasp firmly and make steady traction, and when the word is given move carefully together. The patient's arms must be kept at the side. The turning back is done in the same careful manner.

THE DOUBLE SACS OF SPINAL ABSCESSES.

By EDMUND ANDREWS, M.D.,
CHICAGO.

There is a common error made even by educated practitioners in the technique of draining lumbar and psoas abscesses. The mistake seems to arise from want of knowledge or else want of consideration of the fact that these cavities are generally double, having an internal and external sac connected together by a small aperture. In saying they are double I do not mean that they are bilateral, though that also may be true if the pus happens to burrow out both sides of the spinal column; but the peculiarity which I wish to mention is that the fully developed spinal abscess, even if confined to one side of the body, has usually two sacs, an internal and an external one, connected together, as above stated, by a small channel or isthmus.

The deep, tubercular abscesses differ generally in the style of their burrowing from non-tubercular ones. Owing to the presence of streptococci or other irritating microbes, the non-tubercular abscesses show more inflammatory symptoms, as is seen, for instance, in suppurating appendicitis or other interior inflammations. When non-tubercular abscesses, after forming an interior sac, burrow through the abdominal walls and approach the surface, they glue together the meshes of the connective tissue in front of them by inflammatory deposits, and then perforate the mass without spreading out into a second or external sac of any great size.

The pure tubercular abscess, on the contrary, shows very little inflammatory action until it receives irritating microbes from external sources.

Beginning often at a softened tubercular vertebra, it slowly develops a large internal sac without exciting active fever. When at length it begins to make its way outward, for instance, in the lumbar region, it perforates the abdominal walls by a small opening from the size of a pencil to that of a finger. In the lumbar region this opening is nearly always along the outer border of the erector spinæ muscle. A soft swelling appears, which gives a suc-

cussion upon coughing, like a hernia. There is no inflammation, nor induration. The pus, coming out of its small orifice in the abdominal walls, finds itself in that loose connective tissue between the deep and the superficial fascia. Here it spreads out laterally outside the abdominal walls, lifting the skin and fat and forming its external sac, which sometimes becomes larger than the internal. The sac is now double, and the internal is connected with the external by only a small, round channel.

In other instances the pus burrows downward in the loose tissue around the psoas muscle, and passes under Poupart's ligament by a small opening into the upper part of the thigh. Here it makes its way between the muscles until at some point it perforates the fascia lata and finds itself, as in the former case, in the loose connective tissue between the deep fascia and the superficial fat. Here it spreads widely, making a large external sac connected by a long and crooked channel with the great interior reservoir, from which it derives its pus. In a few cases other routes are followed by the pus, but the general phenomena are similar.

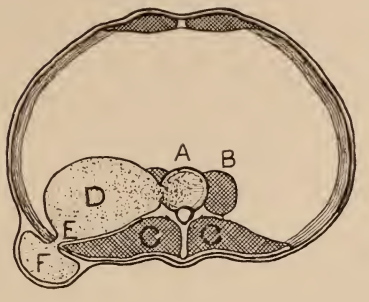
Now this mass of pus, though slowly debilitating the patient, seems almost harmless so long as it is not infected by the entrance of streptococcus or other pyogenic microbes ; but after spontaneous bursting, or on being opened by the surgeon without antiseptic precautions, the external septic micro-organisms find immediate entrance. They multiply and enter every part of both sacs, setting up a septicæmia which is often rapidly fatal.

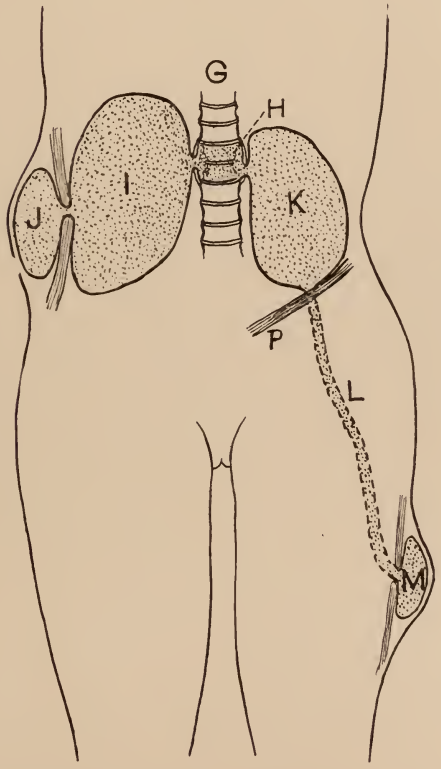
The above facts are so well known to the profession that one feels almost ashamed to state them, yet they are so disregarded or so ill considered in the practice of many fairly educated men that I have felt constrained to mention them in order to make clear the exact mistake of practice to which such forgetfulness leads.

I have for this purpose called attention to the double form of the tubercular pus-sac, one part being internal and the other external, with only a small isthmus connecting them. Now consider the following principles :

1. If the interior and the exterior sacs are both emptied and both washed out by thorough antiseptic irrigation, done daily at first and less frequently afterward, with careful antiseptic dressings on the opening, the formation of pus in many cases gradually ceases and the patient grows plump, rosy, and vigorous under the treatment.

2. If the whole cavity is not kept aseptic, but putrefactive germs find entrance to it, septic poisoning occurs and death often ensues.





The lamentable fact is that the careless practitioner often opens only the external sac, and stops there. Now the internal sac cannot be washed out nor disinfected through an orifice or a drainage-tube which merely enters the external one. Some day the imper-

fection of his dressings or the negligence of the patient admits pathogenic microbes, and, multiplying by millions, they infect both sacs and bring the patient, in many cases, to his death soon after.

The whole thing is simple, but the diagram here presented may help to impress the facts on the memory.

The upper figure represents a transverse section of the body in the lumbar region. A is a tuberculous vertebra. B is the psoas muscle. C C are the erector spinæ muscles. D is the interior sac of the abscess, deriving its pus from the body of the vertebra, A E is the orifice through the abdominal wall, which transmits the pus from the interior sac, D, to the external one, F.

In the lower diagram, H represents two tubercular vertebræ. G is the spinal column. I is the interior sac, deriving its pus from the tubercular vertebræ and transmitting it through the small orifice into the external sac, J. K is a similar interior sac, burrowing down along the psoas muscle beneath Poupart's ligament, P, and thence by a long channel, L, among the muscles of the thigh, until, piercing the fascia lata, it forms the external sac, M.

The forms vary widely, but the diagrams illustrate the main ideas.

The principles governing surgical interference are these:

First, exhaust the milder plans, as follows:

1. In a considerable number of cases a simple aspiration of the pus a few times is followed by a gradual cessation of its production and a permanent cure. It must be done with thorough antiseptic precautions, and its efficacy is increased if the cavity is washed out repeatedly with a 4 per cent. solution of boric acid in sterilized water. Some also finish by throwing in and leaving there a 10 per cent. emulsion of iodoform in sterilized glycerin, putting in half a drachm of the iodoform for adults. The dose can be increased at subsequent aspirations, if well borne. Bruns introduced this plan ten years ago. There is, however, a difficulty in making the emulsion enter the interior sac, where the source of the trouble lies, since the aspirator-needle must usually be only in the exterior one. By injecting after the iodoform a little boric acid solution, and thoroughly manipulating the external sac, some of the mixture can be pressed through into the internal one, unless the channel of communication be pretty long. In our diagram, for instance, it would be difficult for an emulsion thrown into M to get up to K.

2. Some of these cases have so many clots of curdy material in

the pus that they cannot be aspirated. In such instances, a free incision, with an antiseptic washing out and closing the wound again by stitches, is advisable.

3. If these milder plans fail, and an open abscess becomes a future certainty, then the quicker the permanent opening is made the better for the patient.

The operation can be done with complete safety if the opening and the tubing thoroughly reach the interior sac. The dangerous cases are those where the operator opens and tubes only the exterior sac. If this mistake is made, any imperfection of the dressings or mismanagement by the patient may admit germs, which will go on to the inner sac and set up septic action which no subsequent flushing out of the external one will remedy; but if the tube penetrates the inner cavity, the whole thing is safe. If at any time septicism is set up within it, the next dressing and irrigation completely sterilize it, and you are absolute master of the situation.

The technique is not difficult, except in a few cases. If the external sac is in the lumbar region, it should be opened widely directly over the outer border of the erector spinæ muscle; then search with the finger and probes for the opening leading to the inner sac. If this is not of sufficient size already, enlarge it with a blunt-pointed bistoury until it freely admits the whole length of the index finger, and then with the finger and a good-sized flexible britannia-metal sound explore the whole interior. If loose pieces of vertebræ are found, remove them with forceps. If there is a carious cavity in a vertebra, search it for loose pieces, and scrape the interior with caution. Do not wound its surface, on account of the lumbar arteries winding over each vertebral body. If a channel runs down toward Poupart's ligament, follow it down with the sound bent to any convenient shape. If the point can be felt above Poupart's ligament and outside the iliac artery, cut down upon it and draw a large drainage-tube through, having a few fenestra cut near its central part, leaving one end hanging out at the upper wound, and the other at the lower. If there is no downward channel, then put in a long drainage-tube at the lumbar opening, reaching to the deepest part of the inner sac. A tube about one-third of an inch in diameter is the best. Cut only about two fenestra, and those near its inner end. If you have openings near the outer end, the irrigations escape there and fail

to sterilize the deeper parts. Let your solutions wash out the deepest portions.

If the external sac is down on the thigh, for instance at M, proceed as follows: Open the sac M widely, and explore it with the finger and with a britannia-metal sound, passing the instrument up the fistula leading toward the cavity K. By inserting the sound as far as possible and moving it in various ways the finger applied externally will readily detect its upper end somewhere in the channel between M and Poupart's ligament. There will then be no difficulty in cutting down upon it. This being done, draw the sound out below and re-insert it into the purulent canal at the new wound, and again pass it upward. By one or two repetitions of this manœuvre the sound can readily be carried up to the sac K, and its bent extremity felt within it by the finger applied above Poupart's ligament. By cutting down upon the sound pretty close to the anterior-superior spinous process of the ilium there will be no danger to the peritoneum, nor to any vessel larger than the small circumflex ilii artery. Now place a large drainage-tube in the sac, and treat the cavity by antiseptics as before advised. In one instance I found the fistula to lead posteriorly into the pelvis at the sciatic notch. In that case I found traces of an old, partly healed opening just above the posterior end of the crest of the ilium, where I cut in and found the channel again above the pelvis, and then tubed the lumbar cavity. If the sound inserted at the anterior wound runs freely up the psoas sheath into the lumbar region, turn the patient on his side, and, beginning at the outer border of the erector spinæ muscle, cut down upon the sound and put in, as before, a long tube connecting the two openings, carefully exploring the upper sac with the finger and irrigating the whole tract. Saturated boric acid solution is the best irrigation-fluid, but glycerin-emulsion containing, for adults, half-drachm doses of iodoform, can be used after the irrigation, if desired.

As above stated, the essential point is to get a large tube to the deepest part of the interior sac and make faithful antiseptic irrigations. This done, the patient is safe. There is no hectic and no septicæmia. The patient grows rosy, plump, and strong, and in a moderate length of time the production of pus almost ceases. Many of these cases make a permanent recovery.

EXCISION OF THE KNEE AS AN ORTHOPEDIC PROCEDURE.

By W. O. PLIMPTON, M.D.,
NEW YORK.

I ASSUME, in the presentation of this paper, that excision of the knee comes within the scope of the orthopedic surgeon's domain of treatment; that it has its own place as well as mechanics in dealing with pathological conditions of the knee; and that the surgeon should have recourse to it under proper limitations to stay the ravages of disease and save for his patient a useful limb. The success of the operation is no longer an experiment when performed under right conditions and by a skilful operator, and should save not only limbs but lives. The when and how of the operation are matters of discussion, points upon which general surgeons differ, and again the orthopedic and general surgeons take issue. Extreme individual views are entertained by both. This can be only too evident when a distinguished Edinburgh surgeon tells us that all cases, whether of synovial disease alone or those in which the bone is involved as well, should be excised. And, on the other hand, the orthopedic surgeon who would carry mechanical treatment to the verge of amputation is treading upon extreme territory. Excision of the knee should occupy the position of a "golden mean," to be resorted to where mechanical treatment has not and cannot avail, and before amputation is a necessity. That a stiff leg is to be preferred to an artificial limb is a generally recognized fact, and amputation is a last resort greatly to be deplored.

Too much cannot be said in favor of early treatment by mechanical and fixation methods in disease of the knee-joint. And I would emphasize strongly that if the profession at large should recognize disease of this joint in its incipiency, and would employ

or have employed extension and fixation methods of treatment, comparatively few cases would get so far as to necessitate excision. It is the duty of every orthopedic surgeon who teaches, either in the under-graduate or post-graduate schools, to lay special stress upon early recognition, as well as early mechanical treatment, of these diseases. But, alas! the old diagnostic song of rheumatism, strain, or struma, with its treatment-refrain of iodine, blister, poultice, and wait, is still sung by many a general practitioner and surgeon. The result is that, long after the disease has passed its incipiency, the patient is referred, or applies himself, to the orthopedic surgeon for treatment.

A condition of disease more or less advanced presents itself, involving different structures, with deformity more or less pronounced. The skill and experience of the specialist must strike the balance, and determine what line of treatment is best pursued. Where abscesses and sinuses are not present, the immobilization and extension plan should at least be thoroughly tried. A large proportion of cases will yield to this method, and show immediate improvement, with prospects of ultimate recovery.

Since antiseptic methods of operation have so diminished the risks to life and limb, we are justified in interfering in an operative way much earlier than was formerly deemed judicious. Exploratory incisions are in many instances to be recommended. They many times furnish the surgeon with much valuable information respecting the extent of the disease. A finger introduced into a joint with antiseptic precautions will tell the facts, which otherwise would be recognized too late to save limb or life. It is then easy to say what operative procedure is necessary. I think, as a rule, more disease is found than was suspected.

When the fixation and extension plan of treatment has been conscientiously tried, and has not arrested the disease, which is manifestly on the increase, we should explore the joint, and do whatever the conditions demand, whether to wash out or excise. When the articular surfaces are destroyed, the bone and the soft parts extensively involved, the joints should be excised (except, perhaps, in young children, which exception I will mention later). If, however, only the synovial membrane and soft parts are infiltrated, and the joints filled with fluid and cheesy material, it should be washed

out with some of the various solutions recommended by Schede, Koenig, and the late Professor Volkman, of Germany.

The washing may be accomplished by a trocar and canula, first emptying the joint of its fluid contents, then flushing out the parts through the canula with whatever solution is desired. An incision into the joint large enough to admit the finger is to be preferred, since by this procedure we can, through the opening, investigate the extent of the disease, and the flocculent material inside, if there be any which would not pass through a canula, can be evacuated. In Dr. A. M. Phelps' clinic, with which I am connected, at the New York Post-Graduate Medical School and Hospital, the irrigation used is a considerable quantity of a 1 to 2000 bichloride solution, with much kneading and manipulation of parts to bring the solution in contact with the entire joint-surface. The 1 to 2000 should be followed by a 1 to 5000 bichloride solution. The incision is then closed, by first stitching up the capsule closely, and then the outside parts with another line of sutures. The fixation plan may now be continued as before. The result is, as a rule, satisfactory.

The question of how long mechanical treatment should be continued before resorting to operation is still open to discussion. I would say a few weeks or months were long enough to determine if the disease is being arrested. The only valid argument in favor of treatment extending over years in many cases with a severe type of disease, is the hope or possibility of a useful and movable joint, with little or no shortening. But when we see ankylosis result in cases long treated, with the accompanying discomfort or pain during a part or all of that time, with the system exposed to further infection, and others whose joints have been excised walking about with a useful limb and absence of pain, having been treated perhaps only as many months as the first has years, we stop to consider.

Comparing modern statistics in excision of the knee in the hands of good operators, so far as mortality and useful limbs go, when as good a showing can be made (in these two particulars) as in a series of sixty-five excisions of the knee, upon which I shall presently report, we are led to ask why the operation is not done more frequently. Statistics prove that when joints are doing badly operative treatment combined with mechanical gives the best results.

In addition to the class already mentioned as suitable for excision

are the following: Relapsing cases of long standing; abscess cases with or without sinuses, whether containing tubercular or pyogenic infection (with extensive involvement of bone and infiltration of soft parts); cases of osteomyelitis involving the joint; knees with ankylosis in the faulty positions of flexion, luxation, or subluxation, or old arthritic cases, with but little bone disease, which do not yield to mechanical treatment. There is still another class where excision is the only alternative, namely, in those patients who live in a locality where expert orthopedic attendance cannot be had. Also in the case of the laboring-man, who has no means of support while undergoing a prolonged period of treatment. Even though the disease be slight, their circumstances make the operation a necessity. Excision of the knee should not be practised in children under eight, and, preferably, twelve years of age. Cutting at the epiphysis at that time of life greatly interferes with the growth of the limb. Relapses as regards flexion frequently occur. Excision should only be performed in these young cases where the disease is so extensive that no other operation would avail. Arthrectomy or other scraping operation is to be recommended.

All abscesses of joints, whether in children or adults, should be opened and thoroughly drained, sinuses should be laid open, and the necrosed bone cut away by scoop, chisel, or gouge. Drainage through the joint in young patients with abscesses should, if needed, be kept up as long as the disease is active. Fixation should also be continued at the same time.

In looking up opinions on how advanced in age patients may be to bear the operation of excision well, I find it is generally conceded that the danger to life increases in rapid ratio after fifty, although often operations are successful much later. Statistics place the most favorable time early in life.

I must not fail to mention reproduction of tissue through the medium of blood-clot, and its importance in the consideration of surgical treatment of the knee. Since antiseptic methods have made it possible to utilize this most important principle in the reproduction of new tissue, many limbs have been saved which were formerly doomed to amputation, because of the great destruction of bone. It saves the bone in length where many and extensive foci of disease appear in the head, even where it extends into the shaft, by filling

in the spaces and later becoming replaced by bone-tissue. It is not necessary to cut repeated sections from the articular end until no diseased foci can be found, but with a sharp scoop cut them out, allowing them to fill with blood, leaving the healthy bone as the framework from which the new cells may find their way into the clot, thus transforming it into solid bone.

In the series of excisions upon which I shall report there are several examples of great destruction from osteomyelitis and tubercular disease, where amputation was avoided and several inches saved to the length of the limb, by allowing the cavity to fill with blood, through which new tissue was formed. In one case of osteomyelitis as much as seven inches of bone was reproduced. In determining what operation for excision of the knee best subserves the requirements, it may be said that the method which allows of the most complete removal of all diseased tissue, and gives perfect drainage, retains the part in best apposition, and fixes the bones without the use of pins or wire, and last, but not least, the one that can be done with the greatest ease and rapidity is to be preferred. Without entering into a discussion of the merits and demerits of the operations devised and performed by different surgeons, I believe that Fenwick's section of the bone (see Fig. 5), with Phelps' method of removing diseased soft parts together with bone, as described below, fulfils all the requirements mentioned above, with a few exceptions. Where the head of the femur is destroyed, precluding the section according to Fenwick, Dr. Phelps has devised a method to meet this condition by sawing a wedge-shape at the end of the femur and a V in the tibia for its reception. The essential feature in Fenwick's operation is the sawing of the bone in a line parallel to the articular surfaces, so that when placed in apposition the convex surface of the femur fits the concavity in the head of the tibia. The bones are so locked that there is little or no chance of their slipping and no tendency to rotate outward in the dressing. No pins or wires are needed to keep the bones in contact. This is greatly in the patient's favor, since the necessary period of anæsthesia is shortened by ten or fifteen minutes. Where wire and pins are used, they not infrequently give trouble later.

The length of time taken for excision of the knee has an important lesson for us in the statistics respecting the mortality of the

operation. Mr. A. G. Miller, of Edinburgh, in a report on excision, advised against it in certain feeble patients (otherwise suitable cases), recommending amputation because it could be done in a much shorter time, remarking that while in either operation the shock was about the same, the effect of the longer period of anæsthesia was

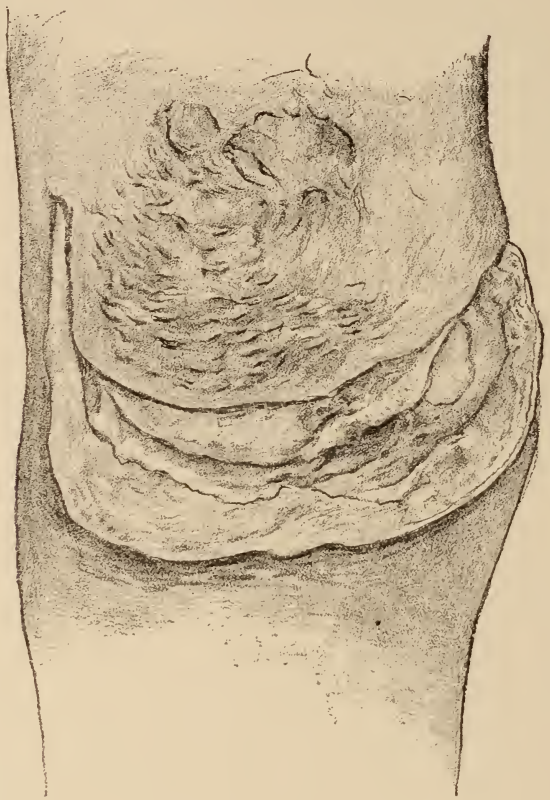


Fig. 1.—First Incision.

to lessen greatly the patient's chance of life. There is a vast difference in the ether-shock, whether your patient is under its influence twenty minutes or two hours. This point is clearly set forth and proven in a series of clinical lectures by Dr. William H. Porter on anæsthesia, delivered before the class of the New York Post-Graduate Medical School and Hospital.

*

The shock of the operation in excision of the knee must of necessity be profound. Add to this the shock produced by ether in an

FIG. 2.—Flap Turned.

operation lasting from one to two hours instead of twenty minutes, and the chance of saving the patient's life is greatly reduced. Except in extreme cases, no surgeon ought, after he is familiar with the

operation here recommended, to take more than fifteen to twenty minutes to operate and apply the dressing. If the steps of the operation, which I will recount, are followed, I think you will be convinced that it can be performed within the time specified.

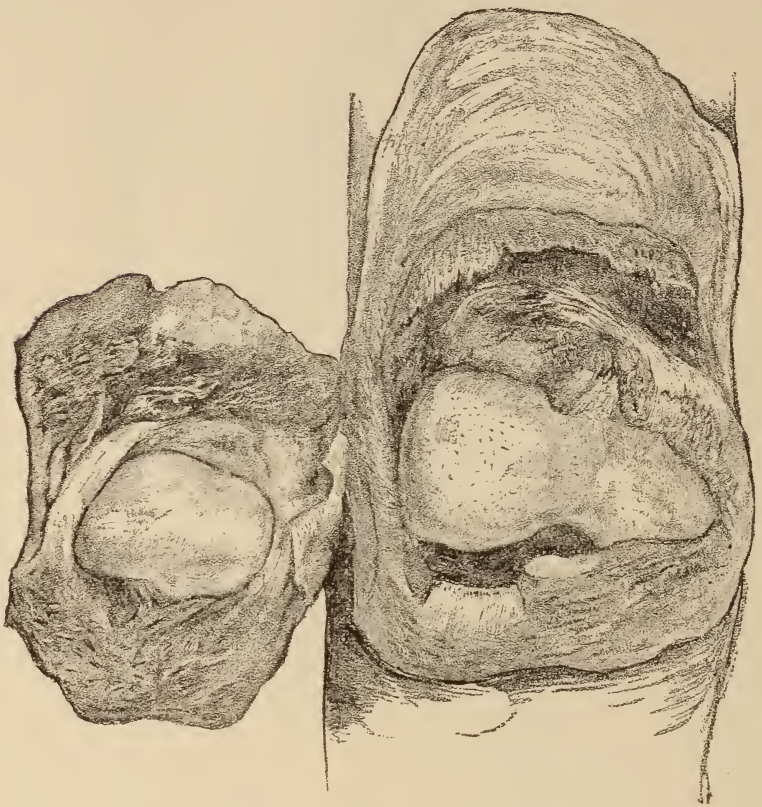


Fig. 3.—The Patella and Capsule of Joint Removed.

Entering the knife a little posterior to and above one of the condyles of the femur, a curved incision is made, extending sufficiently below the patella to expose the margin of the head of the tibia, terminating at a corresponding point on the opposite condyle (see Fig. 1). This incision opens the joint more extensively than any other. Dissect the flap well up, as in Fig. 2. A curved incision above the patella removes nearly the entire synovial sac, together

with the patella (see Fig. 3). Instead of picking at the diseased parts with forceps and scissors before going further, thus consuming valuable time, with consequent danger to the patient, the lateral and crucial ligaments are divided and the knee is flexed, as in

Fig. 4.—Articular Surfaces Exposed.

Fig. 4. With a saw proceed at once to resect the bones, at the same time sawing out a large portion of the diseased soft parts, as well as bone (see Fig. 5). This done, the entire joint is removed, with nearly all of the disease. With scissors and a Volkmann

spoon the remaining disease is quickly cleared away. This concludes the cutting part of the operation. Ligate the three or four arteries if necessary. A continuous suture closes the incision, drainage at the same time being introduced (see Fig. 6). The dressing is the usual gauze and cotton, with plaster-of-Paris extending from the toes to the groin. It is due more to the method, than the skill of the surgeon, that the operation is so quickly performed.

Fig. 5.—Bone Resected.

In children under twelve years of age it is best to resect the hamstrings to prevent subsequent flexion. Dress the limb in a perfectly straight position, else flexion may result later. The limb should be swung up to an angle of about forty degrees. The patient should not walk on the limb without support until after there is solid union. Some form of support, either of plaster-of-Paris or a brace, should be continued from three months to one or more years, depending on the age of the patient and condition of the limb. The younger the patient, the longer the support should be worn to prevent flexion.

It is hardly reliable to quote statistics made before the employment of antiseptics, respecting the mortality of this operation. Quoting from Dr. Phelps' paper of 1888, reports of 329 opera-

tions by different operators give a mortality of 3.03 per cent. In this table I find Fenwick gives one of the best records, viz., 1 death in 28. Miller gives the following statistics: In 30 excisions of the knee, performed in the Royal Infirmary, Edinburgh,[1] 1

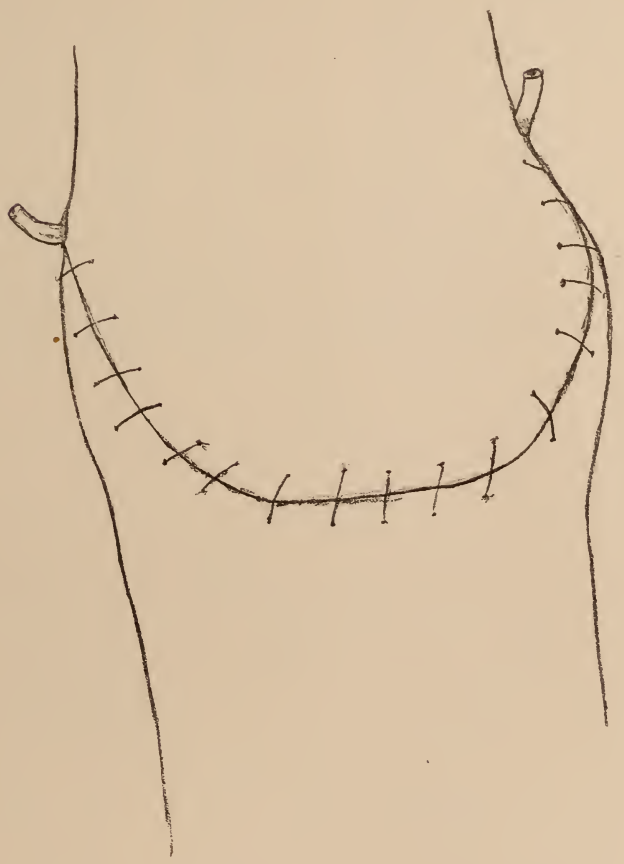


Fig. 6.—Wound Closed.

death occurred; 13 knees were excised for synovial disease alone, the bone not being involved; 18 good and useful limbs resulted; 3 had fairly useful limbs; 5 had to be amputated.

[1] Lancet, February 3, 1893.

Table of Excisions of Knee Performed by Dr. A. M. Phelps.

No.	Name.[1]	Age in years.	Disease.	Operation.	Pus.	Result.	Shortening.	Time in hospital or bed.	Duration of disease.	Remarks.
1	.....	9	Tubercular	.....	None	Imperfect.	.....	3 mos.	Several years.	Flexed to 45°; multiple sinuses. After eight months flexed to 45° again Resected a second time by removing wedge of bone from tibia and making wedge of femur to fit into it. Hamstrings were resected. Perfect result in one year.
2	.....	9	"	Phelps'	"	Perfect	.....	3 "	Several years.	
3	.....	10	"	.....	Yes	"	¾ inch	3 "	1 year	Flexed to 45°; disease of bone and soft parts; bones wired; hamstrings resected.
4	.....	16	"	.....	None	"	.....	3 "	Several years.	Necrosis head of femur; subluxation of tibia.
5	.....	20	"	Volkmann's	"	"	.....	2 "	10 years	Flexed; disease of bone and soft parts; bones wired. Walked on leg four months after operation.
6	.....	13	"	Neuber's	"	"	.....	2 "	6 "	Much flexed; disease of bones and soft parts; bones pinned.
7	.....	21	"	"	"	"	.....	7 weeks	Several years.	Extensive bone disease.
8	.....	20	"	"	"	"	.....	7 "	Several years.	Extensive bone disease.
9	.....	19	"	Fenwick's	"	Death from ether.	.....	.....	Several years.	Patient died at time of operation from excessive administration of ether.
10	M. M.	18	"	"	"	Perfect	3 inches ¾ inch actual.	6 weeks	12 years	Thigh honeycombed with sinuses, flexed at right angles; shortening from operation ¾ inch; leg 3 inches short from non-development. Patient presented at Academy of Medicine 1888.
11	J. H.	53	"	"	"	"	½ inch	7 "	16 "	Had been treated by extension and fixation for one year; used crutches.
12	B. R.	24	"	"	"	"	¾ "	6 "	8 "	Abscess found in both epiphyses; bracing had been tried; of no use. Flexed 45°.
13	L. W.	28	"	"	Stitch abscess.	Imperfect.	¾ "	12 "	8 "	Extensive disease in head and shaft of femur; excavated, and two inches of femur reproduced by aid of blood-clot. Case discharged with bony union, but returned one year later with pain. Cut down on bone, found no disease; dissected out scar-tissue.
14	C. D.	16	"	"	None	Perfect	½ "	9 "	10 "	Flexed 50°; had resisted all treatment. Soft parts and bone invaded, and large foci of disease in bone.
15	R. W.	20	"	"	"	"	¾ "	8 "	3 "	Extensive suppuration and destruction of bone. Had worn fixation and extension splint one year and six months.
16	F. M.	21	Sarcoma	"	"	"	¾ "	7 "	2 "	Not known to be sarcoma at time of operation; joint filled with gelatinous and cheesy material; probably sarcoma supervening on tuberculosis. Disease returned three months later, from which the patient died.

[1] Names of first nine patients not entered.

17	W. P.	12	Tubercular	Fenwick's	None	Perfect	½ inch	6 weeks	3 years	Extension and fixation splints had been worn, with crutches.
18	O. R.	24	"	Phelps'	"	"	1 inch actual.	7 "	20 "	Never had walked on limb; much non-development. Phelps' operation on account of destruction of head of femur. A wedge was made of femur, and a V of head of tibia. She walks well.
19	I. B.	17	"	Fenwick's	"	"	¾ inch	7 "	6 "	Had been braced and used crutches for years. Extensive bone disease.
20	I. L.	31	"	Phelps'	Yes	"	1 "	10 "	20 "	Multiple sinuses; 7 inches of femur removed except shell of bone ¾ inch wide anteriorly and ½ inch thick; V made in tibia; reproduction of 7 inches of femur by aid of blood-clot.
21	G. W.	20	Osteo-myelitis.	"	None	"	1 "	6 "	16 "	Extensive bone disease and many sinuses; flexed 45°.
22	J. H.	24	Tubercular	Fenwick's	"	"	¾ "	7 "	18 "	Joint destroyed and foci in epiphyses; flexed to right angles.
23	W. B.	18	"	"	"	"	½ "	6 "	7 "	Flexed 45°; had been treated without avail; many foci in epiphyses, and soft parts destroyed by infiltration.
24	C. M.	15	Osteo-myelitis.	"	"	"	¾ "	7 "	10 "	Sinuses; much dead bone removed.
25	R. P.	18	Tubercular	"	"	"	¾ "	8 "	12 "	Discharging sinuses; ten years of treatment ineffectual.
26	A. L.	11	Osteo-myelitis.	Phelps'	"	"	1½ "	10 "	7 "	Head of femur destroyed; Phelps' wedge and V operation done.
27	B. R.	31	Tubercular	Fenwick's	"	"	1 "	6 "	18 "	Two sinuses; much dead bone.
28	M. P.	17	"	"	"	"	½ "	7 "	9 "	Great flexion with ankylosis; old sinuses From history probably tubercular.
29	C. N.	12	"	"	"	"	¾ "	6 "	7 "	Treated with braces, but constantly relapsing; foci of disease in both epiphyses; joint destroyed.
30	A. C.	24	Osteo-myelitis.	Phelps'	"	"	1 "	10 "	16 "	Sinuses numerous; flexed 45°; slight motion; removed much dead bone.
31	A. R.	19	Tubercular	Fenwick's	"	"	¾ "	7 "	12 "	Flexed right angles; cartilage gone; soft parts much infiltrated.
32	C. R.	26	"	"	"	"	½ "	6 "	16 "	Flexed 45°; fibrous ankylosis.
33	R. A.	42	"	"	"	"	¾ "	7 "	30 "	Flexed; tender; constantly relapsing; had been treated years.
34	P. C.	21	"	"	"	"	1 "	6 "	11 "	Joint destroyed: slight motion; cartilage gone; foci of disease.
35	J. L.	18	"	"	"	"	¾ "	7 "	8 "	Flexed 35°; discharging sinuses leading to dead bone.
36	C. I.	24	Osteo-myelitis.	Phelps'	Yes	"	1½ "	10 "	16 "	Much bone disease with sinuses; head of femur partially destroyed. Had worn knee-splint for years.
37	N. P.	11	"	Scraping	"	"	1½ "	24 "	4 "	Epiphyses both destroyed; sequestra loose in joint; cavity of bone [invaded.
38	A. B.	19	Tubercular	Fenwick's	None	"	¾ "	6 "	7 "	
39	A. T.	18	"	"	"	"	1 "	8 "	5 "	Had to be re-excised three months later, with perfect result.
40	T. P.	31	Osteo-myelitis.	"	"	"	1 "	6 "	20 "	Old sequestra with disease; cavities in both epiphyses.
41	L. P.	17	"	"	"	"	¾ "	5 "	9 "	Bony ankylosis at right angles.
42	M. W.	27	Tubercular	"	"	"	1 "	8 "	6 "	Extensive disease of bone with infiltration of soft parts.
43	R. G.	7	"	"	Yes	"	¾ "	2 years	2 "	Great destruction of bone and soft parts; burrowing of abscesses; thigh and calf laid open; repeated operation for burrowing of pus. One year in P. H. Hospital, now at Daisy Field's Home, cured.
44	R. A.	21	"	"	None	"	½ "	6 weeks	8 "	Ankylosed at bad angle. Disease was still active.
45	A. B.	27	"	"	"	"	¾ "	.....	21 "	Bad angular ankylosis. Bony union after one year.
46	A. M.	14	"	"	"	"	1 "	7 weeks	6 "	Joint suppurating and bone diseased.
47	R. G.	12	"	"	"	"	1½ "	16 "	7 "	Deformity right, angled; sinuses, joint destroyed and extensive burrowing of pus.

No.	Name.	Age in years.	Disease.	Operation.	Pus.	Result.	Shortening.	Time in hospital or bed.	Duration of disease.	Remarks.
48	C. G.	17	Osteo-myelitis.	Fenwick's	Yes	Perfect	1 inch	10 weeks	12 years	Disease involved lower end of femur; removed large sequestra from shaft; joint destroyed.
49	A. P.	19	"	"	None	"	¾ "	8 "	13 "	Sinuses; disease had partially destroyed both epiphyses; sequestra removed from shaft.
50	W. P.	14	Tubercular	"	"	"	¾ "	6 "	8 "	Bad angular ankylosis; disease still active; joint destroyed.
51	G. W.	28	"	"	"	"	1 "	7 "	12 "	Bad deformity; fibrous ankylosis; joint filled with new material and tubercular foci of disease.
52	W. K.	16	Angular deformity.	"	"	"	¾ "	6 "	12 "	Had recovered from disease with flexion; ankylosis 45°.
53	C. W.	16	Tubercular	"	"	"	½ "	5 "	8 "	Joint filled with tubercular material; capsule ruptured and quadriceps extensively destroyed.
54	E. G.	12	"	"	"	"	½ "	6 "	6 "	Sinuses; joint destroyed; sequestra in head of femur.
55	E. R.	19	"	"	"	"	¾ "	7 "	12 "	Sinuses; diseased bone; extensive invasion of soft parts.
56	J. B.	21	Angular anchylosis, tubercular.	"	"	"	1 "	10 "	16 "	Ankylosis at bad angle; disease still active.
57	G. R.	44	Old osteo-myelitis.	"	"	"	1 "	9 "	31 "	Removed sequestrum from femur after excision.
58	H. K.	24	Tubercular	Phelps'	"	"	1¾ "	12 "	14 "	Head of femur destroyed; Phelps' wedge and V made for union of bones.
59	H. S.	16	"	Fenwick's	"	"	½ "	6 "	8 "	Cartilage loose in joint and bone carious.
60	W. S.	12	"	"	"	"	¾ "	6 "	7 "	Joint destroyed; foci of disease in bones.
61	G. B.	28	"	"	"	"	¾ "	7 "	9 "	Extensive infiltration of capsule and soft parts; cartilage gone and bone carious.
62	J. S.	19	"	Phelps'	"	"	3 inches	10 "	12 "	Head of femur and tibia both gone.
63	A. B.	23	"	Fenwick's	"	"	1 inch	6 "	13 "	Fibrous ankylosis and sequestra.
64	A. W.	14	"	"	"	"	¾ "	7 "	8 "	Was wearing an extension brace; joint filled with tubercular material; foci of disease in bone.
65	B. S.	17	"	"	"	"	¾ "	....	8 "	Still in hospital.

Barker, at the University College, London (January, 1893), reports 25 operations on the knee-joint, without a death, but all but 4 were arthrectomies. Only 4 were excised, one of these being under twenty-one years of age. He is inclined to think, in speaking of the limit of age being a contraindication for excision, that if antiseptic methods are carried out, the time of life is not to be considered more seriously than in other operations of similar magnitude.

Mr. H. G. Hows, from Guy's Hospital, London, reports 130 cases of excision: Four deaths were due to operation, or a trifle over 3 per cent. mortality; 50 per cent. had satisfactory limbs; 8 had shortening over two inches; 7 short from sequestra; most of the remaining had less than one inch of shortening; 21 lost sight of; 12 cases, ages three to twelve years, became much flexed; 10 others slightly flexed; 26 were amputated within three years for suppurating sinuses and necrosed bone; 2 for other causes; 5 died from the amputation.

I have obtained, from the New York Post Graduate Medical School and Hospital, from the City Hospital, and Mary Fletcher Hospital, University of Vermont, Burlington, together with ten from private case-books, the records of 65 excisions of the knee, performed by Dr. Phelps, the table of which I append. I shall here summarize results. No deaths occurred from the operation itself; one patient died from excessive administration of ether while on the table; one died three months after the operation, from sarcoma appearing in the knee after it was entirely healed. A large number of these cases were most unfavorable for excision, inasmuch as the disease was very extensive, multiple sinuses occurring in soft parts, with bones honeycombed with tubercular disease or osteomyelitis. Nearly all had at some time been faithfully treated by mechanics. On most of these Fenwick's section of bone was performed; Phelps' method was employed in a number.

No wiring or pinning of bones was done except in the first cases. No amputations have occurred in this series. All resulted in bony ankylosis, in four months to one year, except one from the Post-Graduate, recently operated upon, in which sufficient time has not elapsed for such union.

Bony union should be considered a perfect result in excision.

One re-excision appears. In one imperfect case a painful scar occurred, which scar-tissue was later removed; subsequently the leg was fractured in a railroad accident, and the case lost sight of.

Operation in only 6 cases was followed by pus. In this series the average age was 20.67 years; youngest, seven years; oldest, fifty-three years.

Average shortening in 57 cases, 0.88 inch; least shortening, 0.5 inch; greatest shortening, 3 inches.

Average time in hospital, 7.7 weeks.

Form of bone-section employed: Not mentioned, 3; Volkmann's,[1] 1; Neuber's,[2] 3; Phelps',[3] 8; Fenwick's,[4] 50.

The average time of operation in the last half of this series will not exceed fourteen and one-half minutes, except in an exceptionally bad case. During the last five years I have assisted Dr. Phelps in nearly, if not quite, all of his excisions performed at the New York Post-Graduate Medical School and Hospital. The watch has been held repeatedly by members of the class of matriculates present, and the time of operation including dressings has oftener been less than more than fourteen and one-half minutes. At the last operation in which I assisted the watches of several were held. It was just ten minutes from the time the first incision was made until the last plaster bandage was in place. The last case mentioned left the hospital in six weeks from the day of operation, with all parts healed. That no mortality due to the operation has occurred in this series of sixty-five cases, I believe, is attributable in a great measure to the fact that the patients were under ether but a very few minutes, hence having very little ether-shock added to that of the operation.

[1] Transverse incision. Patella sawn through. Transverse section of femur and tibia. Patella and bones subsequently wired.

[2] Patella turned up with flap. Transverse incision of femur and tibia. Patella nailed to femur and tibia Bones wired.

[3] Patella removed, wedge made of femur to fit V-shaped incision of head of tibia. Diseased soft parts sawn away with the bone, saving time. Bone lock, no wiring required.

[4] Curved incision of bones parallel to articular surfaces saves time by avoiding wiring and nailing.

DISCUSSION.

Dr. James E. Moore. I would like to ask the Doctor whether in operating or cutting one bone convexly and making a concavity in the other it does not increase the amount of shortening? It would seem to me it would do so a little. It would seem good advice to operate upon these cases at as early a period as practicable. In the cases I have had to operate upon there was no bone to spare—that is, to concave and convex. I had to do the best I could under very unfavorable circumstances; I felt that I could do nothing more than to cut the bone square off. I did not find it necessary to concave one point in order to hold the parts in apposition. I have simply depended upon dressing, as in transverse fractures, and have experienced no difficulty. I have not been able to do an excision in fourteen minutes, nor in twice fourteen; and if these suggestions will enable me to cut down my time to one-half or three-quarters of an hour, I shall be well satisfied.

Dr. Reginald H. Sayre. There is one point that occurs to me in connection with this paper which I think it well to refer to, and that is, in certain cases great atrophy of the leg is produced, so that the shortening is much more than can be accounted for by removal of bone. I have seen one or two cases in which the measurements taken before operation showed that the leg would be extremely small, the child having had knee-joint disease in early childhood; never having walked on either leg; that the shin was short and the feet small, and an excision would have resulted in a shortening of about six or eight inches, and it was the opinion that in both of these cases a better result would follow amputation and the application of an artificial limb than by excision, it being a much more shapely leg for the girl to walk around upon. I think in cases where the shortening is extreme that an artificial limb would be as favorable as a very high artificial shoe which the patient would have to use to enable her to get around. In exceptional cases, therefore, I would advocate that in preference to excision.

Dr. A. M. Phelps. In one of the cases referred to the limb before operation showed something like five inches of shortening. The limb was fixed at right angles, and when I cut down to the joint I found the condyles entirely destroyed. In this case I made a wedge-shape at the end of the femur and a V in the tibia for its reception, and put the two together. The patient now wears a high shoe and walks fairly well, although there are about seven inches of shortening. I regard it as a much better limb than any instrument-maker can make, and any man would come to this conclusion if he had ever seen this patient after operation.

The length of time required for the operation of excision of the knee is a very important factor in these cases, for upon it will depend an increase or reduction in the mortality-rate. The average mortality-rate in series of cases reported by different operators is about 5 per cent., and that percentage possibly may be saved by rapid methods of operating. In excision of the knee it is necessary to make only four cuts with the knife, and the entire joint can be taken out. The saw does the rest. You cut below the patella, turn the skin and soft parts over it, and the saw takes away the entire joint with the patella. That is all you need. The remainder of the time may be consumed in ligating arteries, if necessary, and applying the dressing. If a surgeon cannot put on a dressing in fifteen minutes, he ought not to try it.

Dr. L. S. McCurdy. In regard to the element of time in performing an excision of the knee-joint, I have been told that Dr. Phelps has done an excision of the knee in about three minutes, and that the rest of the time was consumed in the application of the dressing, the total time being about eleven minutes. Dr. Phelps must certainly be very speedy in the direction of excision.

Dr. W. O. Plimpton. I do not agree with Dr. Moore, that sawing bones in curves in resecting shortens the limb more than by the transverse section. I think the opposite is true. You have the convex end of the femur to resect; which convexity you follow in a parallel line. If you remove ever so little, it fits the concavity of the head of the the tibia accurately which you have resected, by a concave section. With the transverse section you

must necessarily remove considerable from the length of the bones, to make the two surfaces approximate.

In consideration of the bad cases mentioned by Dr. Moore, I will say that every one of us meets with such occasionally, and we follow out what we consider the best plan to suit the individual case. Where extent of disease necessitates, you make an excavation in the head of the bone for the formation of the blood-clot. I do not think it is necessary to resort to more extensive cutting to get rid of the diseased bone.

KINKS IN CLUB-FOOT RECTIFICATION, IN HEAD-TRACTION, AND IN HIP-TRACTION.

By A. J. STEELE, M.D.,
ST. LOUIS.

While I have no set paper to offer, yet it has occurred to me I might present a few therapeutic points which I have found to be practical, and which I believe to be new. Since we are all more or less engaged in hospital and dispensary work, it becomes, of course, an important matter for us to furnish our patients with appliances that will accomplish the desired results with the least possible cost to ourselves and to them, so what I shall have to offer will be commendable certainly on the score of economy, as well as simplicity.

CLUB-FOOT RECTIFICATION.

Several ingenious devices have been suggested to hold the foot in correct position while the plaster-of-Paris bandage is being applied and while it is hardening, the objection to the hand alone being that it is in the way during the application of the bandage, and afterward indents the plaster.

Dr. E. M. Moore fastens, by a few turns of the plaster-of-Paris bandage, a thin, properly shaped band to the sole, by means of which the foot is manipulated. Our fellow-member, Dr. Sherman, uses what he has dubbed a "cribbage-board," whereby strips of cloth are so tightened as to draw the foot into improved position and there hold it while the plaster-of-Paris bandage is being applied and while it hardens. Hahn uses a T-shaped piece of wood which, applied to the sole, is incorporated with the plaster-of-Paris bandage, and by means of which—the arms of the T being long and projecting—the foot is twisted and held in correction while the plaster is

setting. Possibly all these methods are good in their way, but in my own practice I have adopted a plan more simple, more convenient, and yet efficient, as follows :

Having primarily divided the plantar tissues and corrected by manipulation the deformity of the anterior part of the foot, and secondarily tenotomized the tendo Achillis, and overcome the equinus, then the foot and leg are encircled with sheet-cotton bandage, and over this plaster-of-Paris bandage, two or three thicknesses, lightly however over the ankle, then a strip of galvanized iron wire gauze, or more properly called No. 6 mesh galvanized evaporating cloth, one-half, three-quarters, or seven-eighths of an inch wide, and eleven, fourteen, or eighteen inches in length, dimensions depending upon the size of the foot and leg, is wrapped partially around the foot, tarsus and metatarsus, one end commencing at the upper and outer part passing inward across the top of the foot, then downward on the inner side, then outward across the sole. Thus the foot is two-thirds or three-fourths encircled with one end of the strip over the plaster bandage already applied, and here it is fixed by a few more turns of the bandage over it and around the foot, the remainder of the strip being disengaged. The foot is now again corrected by strong manual force, everted and flexed—dorsal—and so held while the long, unengaged part of the gauze strip is applied to the outer side of the leg—it should be long enough to reach to above the calf—and there fixed by the assistant with a few turns of the plaster-of-Paris bandage. The metal strip passing up from the outer and front part of the foot to the outer side of the leg acts as a check-rein, both flexing and everting the foot. If the lower end of the strip has been properly wrapped about the foot, the upper end will, when the foot is twisted and flexed into correct position, adapt itself to the outer side of the leg, where, as already stated, it is fastened.

The surgeon may now leisurely apply more bandage over to all the parts, smoothing down the whole. The strip reinforces the plaster, so less of it is used than ordinarily, besides prevents cracking and avoids the necessity of indenting the plaster with the fingers.

There is a small space on the upper and outer part of the foot not covered with the gauze through which the knife may be passed in cutting open and removing the dressing, say, after two or three

weeks. However, if in cutting down in the median line the wire should be encountered, it can easily be snipped with cutting-pliers or strong shears. The open mesh of the gauze and its jagged edges allow prompt incorporation with the plaster, giving a oneness to it all.

I may be permitted to add that I have applied this same principle to the correction of wry-neck. Having divided the sterno-cleido-mastoideus and over-corrected the torticollis by strong force, a tight-fitting skull-cap, made conveniently of an old stocking or a knit worsted helmet, is put on, covering well the head. Over this is evenly applied a plaster-of-Paris bandage in several layers. An ordinary plaster jacket is then applied to the chest, coming up well both front and back. Now, one end of a long strip of wire gauze, possibly two inches wide, is passed over the top of the head, over the plaster, the free part of the strip coming down back of the ear in the region of the mastoid on the side opposite the deformity, and so on down over the front part of the chest. A second or accessory strip, possibly smaller, may also be carried over the head and down the back. A plaster-of-Paris bandage is now quickly carried over the head, covering and incorporating the strips, giving a oneness to the whole. The head is now again forcibly over-corrected, and the long, disengaged part of the gauze strip which applies to the chest, is wrapped in with a fresh plaster roller around the thorax, and at once the head is permanently fixed in this improved position. The uncovered portion of the strip between the head and chest can be wrapped about with soft goods to prevent chafing the skin.

Still another use of the wire-gauze strips in the correction of knock-knee by manual force: The deformity having been overcome, a few layers of plaster-of-Paris bandage are applied to the whole limb, then two long two-inch-wide gauze strips are placed one in front and one behind the leg, corresponding with its long axis, and there fixed—to the leg—by more bandages. Now the deformity is again corrected or over-corrected, which causes the upper portions of the strips to come in line with the long axis of the thigh, over which the bandage is at once applied, and also to the whole limb, and thus immediately the favorable position is retained.

In these three instances the wire gauze acts as a retentive or retaining force pending the setting of the plaster.

Wire-gauze strips are conveniently used in fortifying the plaster in the making of jackets for Pott's disease, the open meshes allowing the plaster to pass through, thus thoroughly incorporating the strips.

For splints the gauze is a very desirable material. With tinner's shears it can be cut into any required shape, as, for example, angular for the elbow. It is flexible and light, yet strong and ventilated. The edges may be bound with narrow strips of rubber adherent plaster. Additional strength can be had by doubling the gauze or employing two or three thicknesses. It may, however, be obtained in the shops of varying weight and strength. I keep several kinds on hand. When used with plaster-of-Paris the edges are not bound, but are left jagged, the better to anchor into the plaster.

HEAD-TRACTION APPARATUS.

A four-tailed bandage can be so applied to the chin and occiput as to afford a cheap and efficient means of making head-traction. The centre of such a bandage is placed on the tip of the chin, the lower part folded under the jaw, and the ends or tails carried up by the side of the head; the upper part is folded on front of the chin, and the ends or tails carried back under the ears, crossing on the occiput and then passing forward and upward to meet the perpendicular tails, to which they are safety-pinned nearly on a level with the top of the head. Holes in the ends of the long tails receive the cross-bar for suspension or traction.

Practically this suspension-bandage had best be made from two strips each two and one-half feet long and one and one-half inches wide, respectively, of dark-brown Canton flannel, wrapped several times around a strip of hair-cloth as a lining, the hairs running lengthwise. Possibly other stiffening material would answer as well. Two edges of these strips are joined, sewed, together in the centre for the space of an inch. The wide strip passes under the chin, the narrow one in front of the chin, thus forming a cup, the strips being stitched where they cross and made still more cupped by taking in a fold or two. A removable piece of soft cloth had best be interposed between the chin and the bandage for cleanliness and to avoid irritation. Several of these bandages can be kept on hand for a

change. I have employed this form for head-traction, both in suspension and recumbency, in Pott's disease and in wry-neck.

EQUABLE ELASTIC HIP-TRACTION.

When making hip-traction in bed we apply a weight fixed to a cord running over a pulley attached to a stirrup fastened to the limb with adhesive strips, the counter-traction being had through the weight of the body from elevation of the foot of the bed. But with a patient on the stretcher-splint or frame, this weight-traction is not practicable, for he patient is to be carried about; therefore for the counter-traction we use perineal straps passing from an arched iron or steel piece above down between the thighs so as to be fixed underneath the canvas covering of the frame. Now, for the traction, in lieu of the weight I use an elastic cord, starting from the stirrup, passing down around a pulley fastened to the iron upright at the foot of the stretcher, then up again, lying upon the canvas, as far as and fastened to the spring of the iron arch, or it may be carried still higher to the top of the frame. Formerly, with an ordinary cord passing from the stirrup to the upright at the foot of the frame, I found its pull was not continuous, for the plasters would slip or the perineal straps stretch. Substituting a short elastic of three or four inches did not improve the matter much, for while at first the pull was equal to three or four pounds, when the plasters would slip the tractile force would rapidly diminish—thus I have never fancied short elastics. But by stretching a long elastic cord over a pulley and so up on the frame two, three, or four feet, we obtain a pull of three, four, or five pounds, scarcely modified by a play of the terminals of a few inches. A small spring-balance is convenient to determine the amount of traction-pull.

The rubber cord referred to consists of from twenty to sixty single rubber strands, making a veritable cable, though not twisted, encased within a woven-cotton cover, ranging in diameter from three-sixteenths to five-sixteenths of an inch; it is also to be had solid. I have been using this same cord attached to handles and passing over pulleys, for a number of years, as an exerciser in lieu of rope and weight, especially in certain exercises for lateral curvature.

For a series of years I have been using as a stirrup a piece of

thin board, for example, from a cigar-box, one and three-quarters inches wide by three and one-half inches long, fastened to the centre of a strip of webbing, possibly twelve inches long, the ends of which passed up on either side of the ankle. Buttons were sewed to the outer side of these strips corresponding to buttonholes in the adhesive plaster straps coming down from the limb above. A hole in the centre of the block allowed attachment for the string or cord. More recently, in lieu of the block and webbing, I have made use of a piece of steel wire, so bent that the ends are hook-shaped and the centre bent around so as to form a ring or eye—length when finished three and one-half inches. The straps of adhesive plaster coming down from the leg should be long enough to reach to just below the sole of the foot, and are there hooked into the bent ends of the wire stirrup, the central ring or eye receiving either the elastic or hempen cord. Two or more sizes of these steel-wire stirrups can be kept on hand, costing a cent or two apiece.

I should previously have mentioned that for a head-traction bar I use a piece of heavy steel wire similarly bent to wire of the stirrup, being strong, cheap, and convenient.

DISCUSSION.

Dr. W. O. Plimpton. The surgeon can easily have a plentiful supply of the material recommended by Dr. Steele on hand, although you might be in a place where you could not get what you want. In that event the simplicity, cheapness, and arrangement of this appliance commend it to me very strongly.

REPORT OF A CASE OF DOUBLE TALIPES EQUINO-VARUS, TREATED BY ASTRAGALECTOMY AND SUPRA-MALLEOLAR OSTEOTOMY.

By REGINALD H. SAYRE, M.D.,
NEW YORK.

G. E., aged twenty-six years, had double congenital equino-varus of the most pronounced type, which had never received treatment before coming under observation. Numerous bursæ were developed over the cuboids upon which he bore almost his entire weight. The bursa on the left foot was especially well-marked, and appeared, when first seen, to contain a movable bony substance; at least that was the opinion of several physicians who examined him. After rest in bed, however, this feeling disappeared, and it was evident that the bursa consisted merely of hypertrophied skin and connective tissue. It extended around the heel in a curious way, forming a sort of cup, which partly enveloped it, and gave his foot the appearance of having had a wedge removed from the heel, as seen in the accompanying illustrations. (See Figs. 1 and 2.)

I operated first upon the right foot. After wrenching the foot partly into position by means of Bradford's twister, the skin on the inside seemed so tight that I resolved to make an open incision after the plan of Dr. Phelps. After cutting the tendo-Achillis subcutaneously and wrenching the foot as far as possible into a good position, I divided, through the open incision in front of the internal malleolus, the skin, deltoid ligament, plantar fascia, calcaneo-cuboid, and astragalo-scaphoid ligaments, and the short flexors of the foot. Although an enormous gap was opened on the inner and plantar surface of the foot, I was still unable to evert the toes completely or bring the foot to right-angles with the leg, and I, therefore, determined to remove the astragalus, as it seemed to be the wedge which

prevented the unfolding of the hinge. The astragalus was removed through an incision carried under the external malleolus, but not without a great deal of difficulty, and the position of the foot, even after its removal, was not wholly satisfactory, as the space between the malleoli did not serve very well to accommodate the os calcis. The wound on the outer surface of the foot was sewed up tight, that in the sole was packed, the Esmarch bandage removed, and the foot put up in a plaster-of-Paris dressing, in a very much improved position, but by no means a perfect one. There was considerable oozing after the Esmarch bandage was removed, and later in the day my house-surgeon removed the packing and tied a bleeding point. There was subsequently a slough of the entire tissue over part of the sole from the skin down to the third metatarsal bone. Whether this was caused by damage to the circulation from the extent of my incision or was the result of the force employed in correcting the foot, I do not know, as on a subsequent occasion, in operating on the other foot, after twisting it violently with the wrench applied outside of an antiseptic dressing which enveloped the foot, I found on removing the dressings, in order to operate still further, that the entire foot was of a dark purple color, the circulation appearing so bad that further operative interference was postponed for fear that gangrene of the foot would ensue. The next day, however, the foot had resumed its normal appearance, and I presume that the congested appearance was due to occlusion of the vessels by the amount of straightening to which the foot was subjected. In consequence of the slough on the sole of the right foot recovery was very tedious, and the resulting contraction narrowed the front part of the foot to the extent of, probably, three-quarters of an inch. On comparing the astragalus which I removed with a normal astragalus from the right foot, the difference between the two is so great that it would be hard to recognize them as being the same bone. The body of the astragalus, as you see, is about half as thick as normal. The superior articular surface is very much flattened longitudinally. The neck bends sharply downward, while the head is concave instead of being convex. The lateral articular surfaces—in fact, all the articular surfaces—present no resemblance to those normally found on the astragalus, and are full of excrescences instead of being smooth. The depression seen between the superior articular surface and the head is due to

FIG. 1.

Front view of feet before operation

FIG. 2

Rear view of feet before operation.

removal of part of the bone by a scoop, in the effort to pry the astragalus from between the malleoli. After examining the astraga-

FIG. 3.

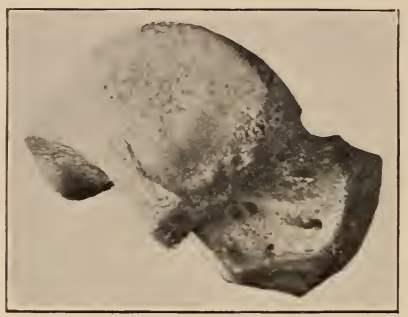
Feet after first operation.

FIG. 4.

Feet after final operation.

lus carefully and comparing it with a normal one, it seemed to me that efforts to restore the foot to a normal position, without its removal, would not have been successful. But the removal of this

FIG. 5.

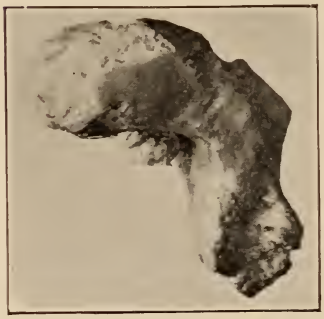


Normal right astragalus, right side.

FIG. 6.

Normal right astragalus, left side.

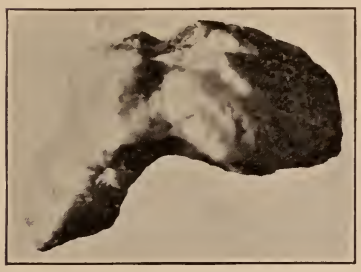
FIG. 7.



Distorted right astragalus, right side.

bone did so little to place the foot in an improved position that, when I came to operate upon the left foot, I determined not to remove the

FIG. 8.



Distorted right astragalus, left side.

FIG. 9.

Distorted right astragalus, front.

FIG. 10.

Distorted right astragalus, rear.

FIG. 11.

Normal right astragalus, front.

FIG. 12.

Normal right astragalus, rear.

astragalus at the first operation, and, if possible, not to remove it at all. In operating upon the second foot, which, as you will see by the photographs, was the more deformed of the two, I was obliged to desist on the first occasion, as I have said, after wrenching the foot around, on account of the very imperfect condition of the circulation, and I therefore did the foot up in plaster-of-Paris in a somewhat improved position, and waited for a week, when I again put the patient under ether, and divided, subcutaneously, the tendo-Achillis, deltoid ligament, astragalo-scaphoid, and calcaneo-cuboid ligaments and plantar fascia, and once more applied force to twist the foot into a normal position. I succeeded, at this time, in bringing the foot into very nearly as good position as the other; the varus was completely overcome, but I could not bring the foot to a right-angle with the leg. I accordingly put it up in plaster-of-Paris in as good a position as I could, and left it for several weeks, when I reapplied a plaster bandage to the foot. After it was hard I cut it completely through, just below the malleoli, around the instep and ankle, removed a wedge-shaped piece of plaster from the instep and brought the foot rather more to a right-angle, inserting a wedge of wood into the gap which was opened above the heel. This manœuvre was repeated several times, at intervals of a week or ten days, with the result of very greatly improving the position of the foot. By this time, the slough on the right foot had healed and both feet were enveloped in plaster-of-Paris boots, and the patient set to walking on them, with the hope that the weight of his body might gradually improve the shape of his feet inside his plaster boots, after the plan of Wolff, of Berlin. After the patient had, however, walked in his plaster boots for several months, his feet were still not quite at right-angles to his leg, and the result of allowing him to walk in ordinary shoes was a slight increase in his deformity. I had cut the posterior ligament of the ankle-joint in each foot on a former occasion without being able to lower the heel sufficiently, the feeling being as if the front part of the foot came up against a bony wall, between the malleoli. In the case of the right foot, I believe the space between the malleoli did not allow the os calcis to fit in well. In the left foot, I presume the astragalus is very much the same shape as that which I have passed around to-day, taken from the right, and that it is impossible for it to be wedged back any further between

the malleoli than it is at present. It seemed to me, therefore, as the articular surfaces of the various bones of his foot were in very good relation to each other and were very comfortable when he bore his weight upon them, that it would be more successful, instead of destroying their relation by an operation through the tarsus, to bring the foot to a right-angle with the leg, by the removal of a wedge-shaped piece of bone from the tibia and fibula immediately above the ankle-joint. This was done subperiosteally, and a wedge of bone taken from the tibia about an inch broad in the front and tapering to a point in the back, and a smaller piece from the fibula. This allowed the foot to be brought to a right-angle with the leg, and at the end of seven weeks the patient could bear part of his weight on the foot without inconvenience. He can now bear his entire weight upon his feet, which are at right-angles to his legs, with the toes everted, and walk comfortably in ordinary shoes, but the foot in which the slough took place is sufficiently contracted in the front to give rise to some inconvenience from crowding the toes together. The photographs which I pass around show the condition of his feet before operation, the condition after the first operation and prior to the removal of the wedges of bone from the tibia and fibula, and the present condition of the feet.

The points which I would like to emphasize are, the very marked differences from the normal presented by the astragalus removed from the right foot; that, in spite of the abnormalities which the left astragalus presumably presented to an equally striking extent, the left foot has been restored to a position much more resembling the normal than has been obtained in the right foot, although the astragalus has not been removed; that in certain cases of talipes, which are not susceptible of perfect rectification without bone operations, it may be more advisable to remove a wedge of bone from the tibia and fibula, rather than to destroy the articulations of the tarsus. Careful examination of the astragalus makes me think that an osteotomy through its neck would have been preferable to its removal, but the excellent position of the left foot makes me doubt whether either of these proceedings would have been wise in the case under consideration.

DISCUSSION.

Dr. V. P. Gibney. It occurred to me while Dr. Sayre was showing this foot and recounting the obstacle of which he speaks that the obstacle can be overcome by simply making an incision over the head of the astragalus, chipping it off, then easily getting it in good position. I have photographs in my pocket showing this very nicely. It is difficult to manage these cases unless you have them under your care for a considerable period. A child happened to be under my care, many years ago, that was treated faithfully by the old method, the tendons having been divided and the feet put in plaster-of-Paris. The case has been under Dr. Phelps's care. An open section has been done in both instances. I find one operation was performed in May last at the Post-Graduate Hospital. One operation was done in March by Dr. Phelps, the other by some other surgeon, and kept there only a short time, and yet the case has relapsed. My comment on this case is simply this, that it is better very often to supplement Dr. Phelps's open incision with removal of the head of the astragalus. I have found it so frequently necessary.

Dr. A. J. Gillette. A few years ago in Philadelphia we were shown, if you remember, a number of cases where the astragalus was removed for the cure of club-foot. The operation being made and the foot brought into position so simply and quickly that it impressed me very much, and I thought I would try it in the next case of club-foot that came under my care. In the older cases where I removed the astragalus I was very enthusiastic over the results for several months, but to-day I am not proud of those cases. They have badly shaped feet, and are not nearly so good as those cases in which this operation was not done. I got the deformity of flat-foot later on, and I find I get as good results by not removing the astragalus. In Phelps's operation I have never had a case of deformity recur, or else it was because the patients applied to me before it had returned to the former position. In the cases I have been able to bring the feet in position they have required watching for some time.

Dr. A. M. Phelps. In regard to the cases presented by Dr. Gibney, which illustrate the necessity of cutting through the neck of the astragalus and removing it, I hardly think the case presented illustrates that point. In the series of cases which I reported as having been operated upon by open incision, on a former occasion, there were eight or twelve reported as relapses. These cases did not relapse because the head of the astragalus was not removed. They simply relapse because they drift away from the surgeon, and have a habit of pulling the feet around and walking on the dorsal aspect of the foot; in other words, the patient pulls his foot around, and if he continues so to do the foot will relapse. We find that these cases drift away from us and within two or three months thereafter they are quite likely to relapse. I am glad to get these cases, so that when I republish my statistics I shall drop a line to the different dispensaries to report to me such cases as have relapsed, in order that I may get accurate results.

In 1884 I laid down a rule that I believe we should follow in these cases of club-foot, or when we decide to operate upon them. I recommend subcutaneous tenotomy with strong manipulation to begin with. The second step is to do open incision, dividing the tendo-Achillis first. The third step, removing the astragalus, if the foot does not come around to pecis, cut through the neck of the astragalus, pull the foot around, and then straighten the neck of the astragalus. If you fail in this measure, remove a V-shaped piece with the knife from the body of the os calcis. If you fail, take away the scaphoid and cuboid; but it is only in exceptional cases that you will find it necessary to resort to these extreme measures. If you do not accomplish the desired result, begin by cutting the soft parts, and if you fail in that cut the hard parts. If you cannot get the foot around to a super-corrective position, then do a Pirogoff's amputation. In two or three cases I have done Pirogoff's amputation and secured a very desirable stump.

Dr. Huntley is present. Three years ago I operated on his feet. He was then forty-one years of age, and although his deformity was not so severe as some of the cases we encounter, I succeeded in straightening his feet, and if there is no objection, I should be glad to have the Doctor tell us something about the history of his case.

(Here Dr. Huntley gave a detailed description of his own case.)

A LEG-APPARATUS FOR SPASTIC AND PARALYTIC CASES.

By G. W. FITZ, M.D.,
CAMBRIDGE, MASS.

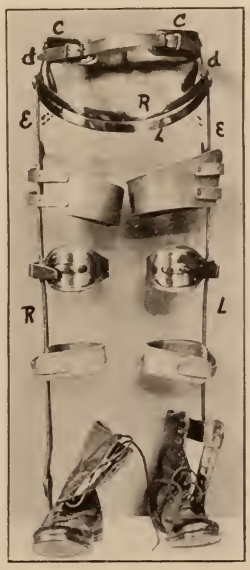
The leg-apparatus here described was devised for a case of spastic contraction of the thigh adductors in the Children's Hospital, Boston, 1891. It was designed to meet the following conditions:

1. To support the legs;
2. To determine the movements of the legs in the plane proper for walking;
3. To be light and to utilize the strength of the leg-bones as far as possible;
4. To be so adapted to the movements of the legs as to make walking easy;
5. To support the weight of the trunk and prevent ungainly oscillations at the hips.

As will be seen by reference to the cuts, the basis of the apparatus is a pelvic girdle, getting a firm support below the crest of the ilium. The girdle consists of two steel pieces, *c c*, fitted to the sides of the pelvis and connected before and behind by straps with buckles for adjustment. From this girdle a steel offset, *d*, drops down on each side to a point over the head of the femur. Pivoted to these offsets from the girdle are two leg uprights, fastened to the shoes and having ankle-joints and ordinary calf, knee, and thigh supports, as shown in the cut, but differing from the ordinary apparatus in having an attached steel band bowing obliquely forward and across to the other side, where it pivots with its fellow, thus making a broad axis to determine the movement of the leg. There are thus three parts entering into each side-joint e g, at the right hip, first, the offset from the girdle, d; second the upright, R, carrying the transverse bow, and, third, the tip of the transverse bow, from

the left side. The right bow is made longer so the left shall pass inside in walkng. If it is necessary to stiffen still further the brace, it is possible to weld a piece of steel, indicated by dotted lines in Fig. 1, e, to the transverse bow, starting from the end of its first fifth and leading down obliquely to the upright. It is here that the greatest strain comes, since the transverse arc and the upright act as an ⊤ lever to support the weight of the trunk and keep it from sagging at each step. The upright utilizes the strength of the leg bones longitudinally, and its weight can be reduced by taper-

Fig. 1.



ing from above downward; but it must be made strong enough to withstand the leverage strain that comes upon it at the hip in paralytic cases. The-leg movements are limited to the antero-posterior vertical plane in which the ordinary walking movements take place, and the apparatus gives assistance to the muscles involved by supporting the body-weight. Fig. 2 shows the position of the different parts as separated in the act of taking step. Fig. 3 shows the position in sitting. The parts are labelled to correspond with each upright.

A lock knee-joint can be introduced as in Burrell's apparatus, and

perineal bands may be applied, as in a hip-splint, to give full support to the trunk.

Applied to cases in which there is contraction of the thigh adductors or abductors, the apparatus holds the legs in correct posi-

Fig. 2.

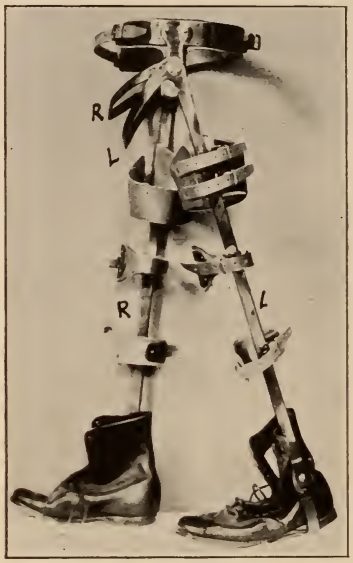


Fig 3.

tion, and at the same time permits easy walking. In paralytic cases with some residual power, walking is possible, since the muscles are relieved of the weight of the body, and have only to guide the legs in their restricted plane of movement.

A MODIFICATION OF BRADFORD'S FRAME FOR EXTENDING THE SPINE IN THE DORSAL DECUBITUS.

By J. SELVA, M.D.,
BOSTON.

Rest and extension of the spine are in general the most essential conditions in the mechanical treatment of spondylitis. To accomplish either one of these, or both, when the patient is in the

Fig. 1.

The Bradford frame for fixation and recumbency: the patient is moved about.

dorsal horizontal position, many apparatus have been used, of which the following are the most important: Rauchfuss's, Lorenz's, Redard's, and Bradford's.

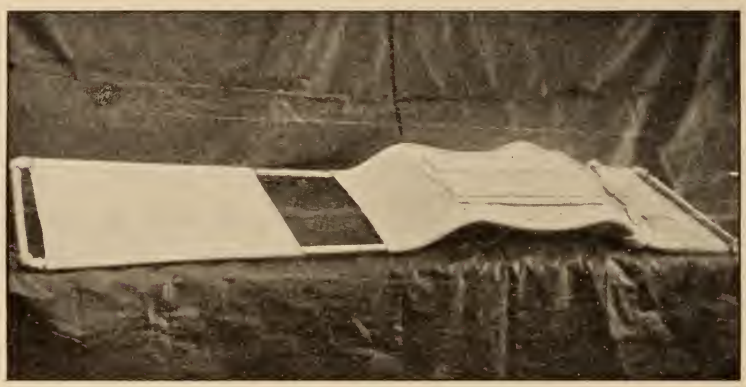
Rauchfuss's extension-bandage is made of a piece of cloth attached to each side of the bed and a few inches above the mattress. The patient is placed in such a manner that the kyphosis rests upon the centre of the bandage.

Lorenz applies extension to the spine in the recumbent position, by means of a plaster cast, which is shaped to the patient's back. He also uses extension by placing the patient on the ventral decubitus and elevating the head by a pad under the forehead.

Redard's apparatus consists of a frame provided with a hinge at the seat of the kyphosis. There are supports for the head and arms, and the patient lies on the ventral position.

All these appliances have the disadvantage of being impracticable for general use.

Fig. 2.



Modification of Bradford's frame; lateral bars bent up; pads in place.

The Bradford frame, however, is very simple, practicable, and useful (Fig. 1). It secures fixation and recumbency, and allows the patient to be moved about; but it does not bring about extension of the spine. It is made of four gas-pipe bars united together in the shape of a rectangle.

My modification of Bradford's frame provides for extending the spine in the dorsal decubitus. The modification consists in having the lateral bars of the frame bent up, so that the patient's back, at the seat of the deformity, is on a higher level (four to five inches)

than the head and limbs. The method of accomplishing extension by means of this appliance is illustrated in Figs. 2 and 3. The

FIG. 3.

Modification of Bradford's frame, applied.

height at which the spine is raised can be regulated by loosening or tightening the straps of the covering. Pads are placed on each side of the spine to prevent undue pressure.

SLIPPING PATELLA.

By E. H. BRADFORD, M.D.,
BOSTON.

This affection has received but little attention in surgical literature, although it is not of great rarity, and may occasion a great deal of discomfort. The following cases may serve as illustrations:

Case I.—A healthy girl of fourteen years presented herself for advice on account of a slight effusion in the left knee. She stated that a few weeks before her patella had slipped to the side, and had been replaced after twisting the limb. Some pain had followed, with swelling at the knee, obliging her to remain quiet for a few days. There was at the time of examination a slight effusion in the left knee, but nothing else could be observed. The patella floated and could be pushed to either side. A retention-appliance was used and massage and electricity advised. The treatment was carried out faithfully, but, in the subsequent history given, occasional attacks of a similar nature occurred if the strap was laid aside or worn loosely. The case was followed for twelve years. The knee became gradually stronger, and the patella, after the patient grew to adult life, was dislocated but rarely, not oftener than once in a year. The appliance was worn for two years and finally discarded. The limb never, however, became as strong as the other, and some muscular atrophy followed the use of the appliance. After the lapse of a number of years the disability, however, was not sufficient to cause more than a passing annoyance.

Case II.—A young man of twenty years dislocated his patella while dancing, and was brought to the hospital, where the patella was reduced under an anæsthetic. The subsequent history of the case was not known.

Case III.—A woman of twenty-five years presented herself

with the statement that she had for years been annoyed by the occasional slipping of the patellæ of both knees. The attacks did not occur more frequently than once in a few months and were not followed by synovitis or effusion, but were sufficiently annoying to interfere with her occupation, that of a domestic, and gave her a constant sense of insecurity.

CASE IV.—A healthy young lady of twenty-two years complained of occasional attacks of slipping patella of the left leg. The attacks were not sufficiently frequent to cause her great annoyance, though they occasioned a sense of insecurity in walking.

CASE V.—A nurse, a woman of thirty-seven years, had suffered for five years from a slipping patella. Nothing could be discovered on examination of the knee except a weakness of the extensor cruris muscles. The patient was placed under the care of Dr. Douglass Graham, who took charge of massage and muscular development, to the great benefit of the patient.[1]

CASE VI.—A rapidly growing girl of thirteen years suffered great annoyance from frequent attacks of slipping of the patella of the right leg. These attacks were accompanied by considerable pain, great distress, and, although the deformity corrected itself in a few seconds, there was at times great disability. The patella was secured in place by means of a supporting appliance which has been worn for three years. In addition to this, massage and electricity have been employed. The patient has gained in strength, and at present has been free from any attacks of slipping patella for a year. The muscles, however, of this limb are smaller at the knee than on the other side.

CASE VII.—A child of eight years presented herself at the hospital suffering from congenital dislocation of the left hip, for which she underwent Hoffa's operation. On examination it was found that she was able to dislocate her right patella at will. This could be done only when the leg was bent at the knee. It is accompanied by a slight twist of the tibia outward ; no pain was occasioned by this. An examination of the knee showed no absence of the bony ridge on the outer side of the fossa of the patella, but the muscles were relaxed and feeble.

[1] Douglass Graham : Treatise on Massage, p. 279.

The foregoing cases illustrate the fact that the affection is more common in girls and women than in men and boys; that the attacks of dislocation of the patella are, as a rule, accompanied by little pain, but by a sense of great discomfort; occasionally some effusion follows an attack, but this latter is by no means constant. As a rule,

Fig. 1.

Patella in normal position.

the patella can be replaced by the patient with a quick movement of the limb, but at times this is accompanied by pain. Sometimes an anæsthetic is necessary for the reduction. In none of the instances here mentioned was there any noticeable lengthening of the ligamentum patellæ mentioned by Dr. Newton Schaffer, though this was

found in the case mentioned later. After many attacks of dislocation, the patients complain of a sense of insecurity in walking, which in severe cases may amount to a distressing disability, limiting the patient's ability to walk or engage in active occupation. The affection seems to be due to a lack of tonicity of the extensor

FIG. 2.

Patella dislocated.

cruris muscle, especially of the lower fibres of the vastus internus, probably also a lack of strength and laxity of the internal lateral ligaments, passing from the internal condyle to the patella and connected closely with the capsule. An examination of a number of femora indicates that an absence of the ridge between the

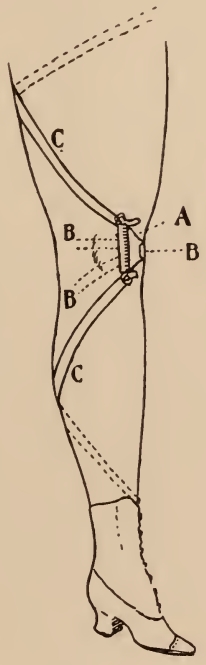
outer condyle and the fossa of the patella is not to be regarded as a cause of this affection. The fact that the accident takes place with a limb in a partially flexed, rather than in a straight position, is probably due to the advantage which the fibres of the lower part of the vastus externus have when the limb is slightly bent. If for any reason the corresponding fibres with the vastus internus are weakened, or the ligaments are less strong than normal, the patella can be pulled by violent muscular exeertion to the outer side. The dislocation is always to the outer side for the reason that greater strain comes upon the internal ligaments from the habit of walking with the foot turned out slightly, and from the frequency of knock-knee in women.

Mechanical Means for Securing a Slipping Patella. There are many devices for retention of a slipping patella. The elastic knee-cap which is frequently recommended, will be found of little service; it presses the patella downward upon the femur without exerting pressure on the sides of the patella. If, however, an elastic knee-cap is split in front and furnished with lacings or straps, and if felt pads are sown upon the sides of the cap at such places as would exert pressure upon the sides of the patella, an arrangement is furnished which, when properly adjusted, will give a serviceable support in lighter cases, allowing motion at the knee. A more efficient and less comfortable support can be made by taking a cast of the limb, and upon this moulding a leather knee-cap, which can be laced about the lower thigh, knee, and leg. This does not permit bending at the knee, and exercises some pressure on the sides of the patella and entirely prevents its slipping. It, however, favors the development of atrophy, but is of value after a severe attack followed by effusion, and a is means of retention of the patella until the strained ligaments have recovered their strength.

The following steel appliance will be found of service: It consists of two uprights, hinged at the knee, extending from the middle of the calf to the middle of the thigh on each side of the limb, and connected with cross-pieces above and below. To these are attached at the level of the middle of the patella semi-lunar plates, which are of such a shape and are bent in such a way as to press upon the sides of the patella. They are covered with padding and leather. If leather straps pass diagonally from the uprights to button upon

the top and bottom of these plates, an adequate amount of side pressure will be secured. Two straps from underneath the knee prevent the apparatus from falling forward, and the straps mentioned prevent the apparatus from slipping backward. It is essential that this appliance should not remain in a bent position, as the

FIG. 3.



Strap to restrain slipping patella. A, a strip of leather to which a rubber tube is secured pressing against the outer edge of the patella. B, a piece of adhesive plaster secured to the leather and applied to the outer side of the knee. C C, webbing straps fastened below and above to the waist band and boot, and by means of buckles to the leather piece, A.

pressure at the sides of the patella would in that case be diminished. To prevent this a spring is furnished connecting the upper portion of the upright with the lower portion, and with sufficient strength to force the appliance into a straight position, but allowing bending of the knee by muscular effort. This appliance is somewhat heavy and cumbersome.

Massage and Electricity. It is manifest that no cure can take place except through the development of the muscles or improvement in the strength or length of the ligaments. In certain cases reliance can be had upon the natural development in the growth of the patient, and it is simply necessary for recovery to prevent, during the growing period, the ligaments from the additional strain of the frequently displaced patella. Massage and electricity are manifestly indicated in all cases.

Operative Measures. Bijardi (*New York Medical Record*, April 20, 1895) describes an operation which he performed upon a congenital dislocation of the patella in a child of four years, where dislocation of the patella could be produced at will and without pain. He excised a semi-lunar piece of the internal capsule ligaments and sutured the cut edges. His patient is reported as cured. He has collected thirty-four cases of congenital dislocation of the patella, but none of these were operated upon.

Dr. Gavin, of Boston, in an unreported case, shortened the internal lateral capsular ligaments in a case of relapsed capsule, and this has also been done by Dr. Perkins, of Kansas City, in a case of traumatic dislocation of the patella.

In the following case operative interference was undertaken. The patient, a healthy young lady, had suffered from slipping patella since the age of thirteen. Gymnastics, massage, electricity, and an apparatus had all been employed with thoroughness for years. By means of a proper appliance the patella had been retained in place for a long time, but on loosening of the apparatus slipping of the patella was liable to occur, and interfered seriously with the patient's activity. Through the courtesy of Prof. Dwight, experiments were made upon the cadaver to determine the best incision to allow the shortening of the capsular ligaments on the inner side of the knee, and also a transplantation of the ligamentum patellæ, or shortening it in case it was found lengthened.

March 6th, both knees were operated upon. A semi-lunar incision was made along the inner side of the knee a half-inch anterior to the tubercle of the internal condyle. The upper end of the incision extended three inches upward and the lower portion curved so as to cross the ligamentum patellæ at its insertion on the tubercle. The ligamentum patellæ was found one-half inch longer

on the left side than on the right. It was also thinner than normal; it was, therefore, divided by means of an oblique incision passing from without inward and downward. After the skin flap had been made a curved incision was made through the capsular tissue of sufficient depth and extent to allow drawing the patella to the inside if the divided edge was pulled upon. This was done without directly opening the joint, the serous surface of the synovial sac not being interfered with. After drawing the cut edge to the inside by means of forceps it was stitched one-half inch nearer to the condyle. At the same time the patella was forced down by the hands of an assistant, and the divided ligamentum patellæ was stitched in such a way that half of the cut edge on the inner side was secured to the aponeurosis of the leg a half-inch lower than its previous position. The remaining portion of the obliquely incised ligament was stitched in such a way that the upper portion was slid one-half downward, the lower portion was brought up and sewed to the side and top of the ligament to reinforce its strength. The sutures were both catgut and silk. The skin was then sewed with uninterrupted sutures. On the right leg the ligamentum patellæ was found to be less long and less thin, and was not divided. The patella on the right side was pressed to the inside by the hand of an assistant, and the loose capsular tissue was folded upon itself and a pleat sewn at the side half-way between the patella and the internal condyle. After the proper aseptic dressing the limb was secured in plaster-of-Paris bandages.

The operative recovery was uneventful. On the removal of the plaster bandages laced leather supports were applied and the patient allowed to stand on crutches. After discarding the leather supports straps were used to prevent a possibility of the slipping of the patellæ. This was effected by means of a pad consisting of a large rubber tube sewn to a piece of leather and placed at the outer side of the patella, the tube being long enough to extend slightly beyond the end of the patella. This was secured in place by means of a strip of adhesive plaster which passed under the thigh and leg obliquely. At each end of the leather a buckle was placed, and to this the webbing straps could be attached. These webbing straps were fastened to elastic webbing and passed obliquely around the thigh above the leg and below, and fastened to

the waist-band and shoe. When the webbing straps were buckled firmly the rubber pad was pressed firmly against the outer side of the patella, and any requisite pressure could be made, preventing any possible slipping of the patella and avoiding the circular compression of the muscles causing atrophy, and not preventing bending of the knee. The patient was allowed to walk first with crutches, then with a cane, and finally discarding the cane. The left leg was kept stiff by the use of a leather appliance for two months, and later the straps were worn for a time. All appliances were discarded from the right knee three months after the operation, and after five months from the left knee. Ten months after the operation the patient appears to be entirely well, and has improved in strength and agility and has been entirely free from any slipping of either patella or the sense of insecurity.

The operative treatment of this disability recommends itself as easy of execution and free from danger, and is of advantage in all cases where the disability is not remedied by conservative treatment. Where it is sufficient to take a fold in the capsule without opening the joint it is certainly advisable to do so in preference to dividing and shortening the ligamentum patellæ. The transplantation of the ligamentum patellæ will not be necessary except in the severer cases.

DISLOCATION OF THE PATELLA.

By JOEL E. GOLDTHWAIT, M.D.,
BOSTON.

Dr. Bradford was to have read a paper on the treatment of slipping patella, and in connection with it I had planned to show the photographs of a case which I operated upon about the same time that he operated upon his case. These photographs were taken from a woman who came to the Orthopedic Clinic of the Carney Hospital, in Boston, having had a dislocation of both patellæ for twenty years. They slipped out, as she says, when she was ten years of age. She was an old rhachitic subject. She is a seamstress by occupation and uses a sewing-machine all day long. She had gotten along until the present time with moderate comfort. I will pass these photographs around, showing her condition. The operation consisted in making a long oblique cut across the knee, exposing the capsule, which was so much contracted upon the outer side that without dividing this it was impossible to slip the patella over into the trochlear groove. The capsule was slit on the outer side, the wound being about three inches long. With this it was possible to get the patella back in its place, but the attachment of the patellar tendon was so far cut on the tibia that it slipped out again as soon as it was let go. The tendon was then cut entirely off, periosteum over the inner side of the tibia freed, and the tendon sewed to this periosteum. The loose capsule on the inner side was then taken up by a through-and-through quilted suture. To relieve the strain, the attachment of the quadriceps muscle to the patella was cut off almost entirely, leaving a little aponeurosis at the back. The wound was closed without drainage. It was a first-intention wound. The patient was up and about in five or six weeks. She wore a knee-cap, or rather a leather leg-splint,

to confine the joint for four or five months. She is able to walk around now perfectly. Only one leg has been operated upon. I did not think it advisable to operate on the two legs at the same time. There is free motion at a right angle, as shown in the photograph; the patella is in its normal place, and the attachment of the patellar tendon seems to be strong enough.

DISCUSSION.

Dr. Royal Whitman. If I understand the matter rightly, this slipping patella was the result of confirmed knock-knee.

Dr. Goldthwait. Yes.

Dr. Whitman. In confirmed knock-knee the tibia is rotated outward, and if you transplant on the inner surface, so that the crest of the tibia still points outward and the insertion of the tendon is on the inner surface, the motion is good.

Dr. James E. Moore. I think the suggestion made by Dr. Goldthwait is a practical one; that is, to chip off a portion of the tibia in transplanting it rather than depend upon sewing the tendon to the periosteum. It is a much better way to do it. We have an analogous operation, I might say, in operations for excision of the hip-joint, in which we chip off the trochanter, etc. That is a satisfactory procedure, and I can imagine it would be equally so in this case.

Dr. Goldthwait. I have nothing more to say, in closing the discussion, other than that I tried twice to get the tibia back into proper relation with the femur; but the deformity had existed so long that it was permanent, and I could not keep it there.

REPORT OF A CASE OF CONGENITAL DISLOCATION OF THE SHOULDER BACKWARD.

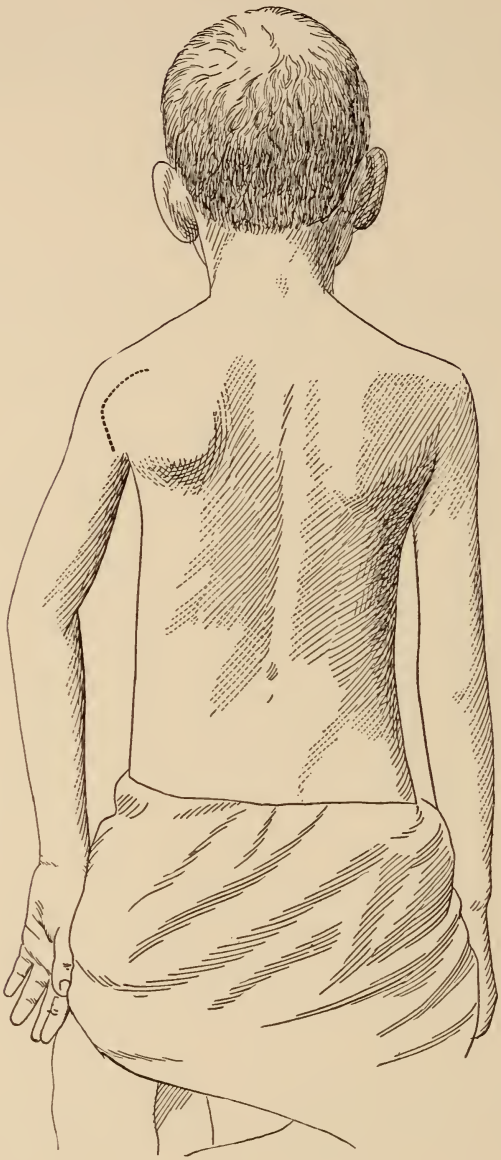
By A. M. PHELPS, M.D.,
NEW YORK.

During the month of April, 1895, Judge A., of San Francisco, brought his little boy to me for consultation. Upon examination I found that the head of the humerus was dislocated backward underneath the spine of the scapula. The father told me that this condition had existed from birth. The boy was now eight years old, and presented the appearance as seen in Figures 1 and 2. It was impossible for him to put his hand to his mouth, and the arm was rotated inward, turning the palm of the hand backward. The power of rotating the arm, so as to place the hand in a supine position, was impossible, and the motion at the shoulder-joint was almost *nil*, the scapula moving with the arm.

The father had consulted several surgeons on the Pacific Slope and the West, and all had advised against an operation. In this city he had consulted Dr. Wm. T. Bull, Dr. Louis A. Sayre, and others, Finally, in consultation with Dr. Gibney and Dr. R. T. Morris, at my office, we decided to operate, leaving the technicalities of the operation to my judgment. Accordingly, at the private sanitarium of Dr. A. Palmer Dudley, in Madison Avenue, this city, assisted by Dr. Dudley and Dr. W. O. Plimpton, I cut down upon the head of the bone, making a curved incision, following the posterior margin of the deltoid muscle, as seen in Fig. 1. Then the flap was turned downward, the edge of the deltoid muscle raised, the capsule incised, and the end of the bone exposed. With the aid of my finger, I found that the posterior border of the glenoid cavity had been broken away, and the cavity was about two-thirds of its normal size. I cut away a portion of the end of the humerus, and rounded

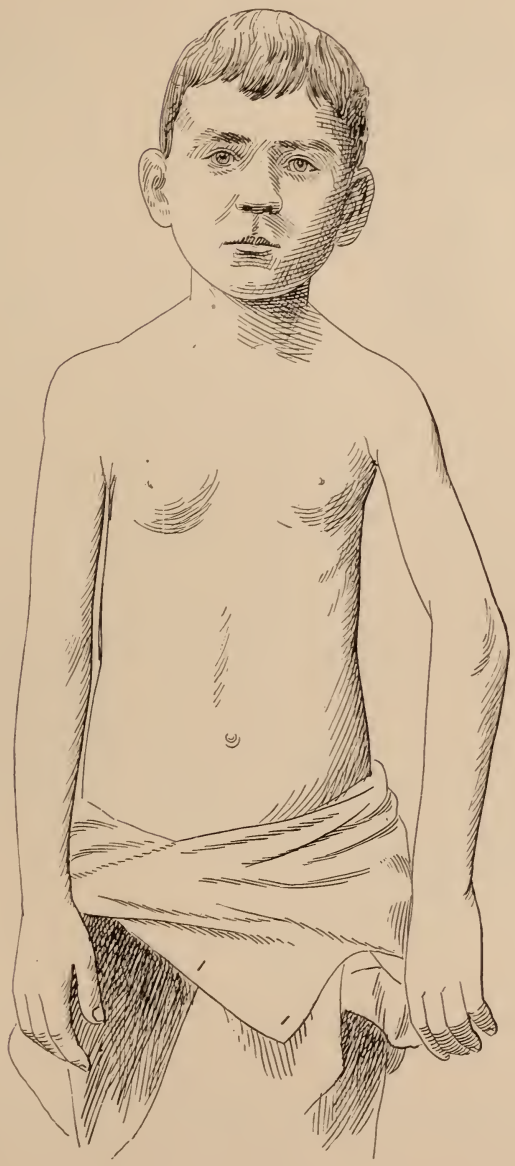
it off so as to make it fit the original socket. I then dissected away a part of the redundant capsule, and resected the new articulation

Fig. 1.



formed by the head of the bone. The capsule was then stitched up with kangaroo-tendon behind the end of the bone. A rubber

Fig. 2.



drainage-tube was inserted into the joint, which was removed at the end of one week, when the wound was found to be entirely healed. Figs. 3 and 4 show result of the operation.

FIG. 3.

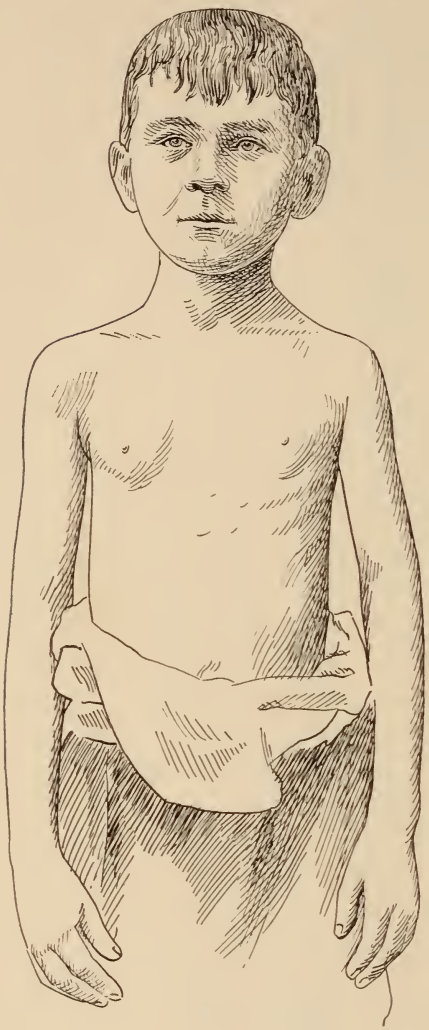


FIG. 4.

I presented the case at the Academy of Medicine before the Orthopedic Section in April, 1895, three weeks after the operation.

One important fact to be mentioned was that after I had liberated the end of the bone from all of its fibrous attachments I could not rotate the arm to its normal position. This was due to the winding around the bone of the pectoralis major and other muscles which are inserted into and around the bicipital groove, and rotation could not be effected until the bone was restored to its normal articulation.

In this operation the attachment of muscles was but slightly disturbed, and the result of the case has been almost a perfect result. The father writes me that this arm is now nearly as good as the other; it is but a trifle shorter, and the boy possesses all the movements of a normal arm, except that he is not yet able to raise the arm perfectly perpendicular, but which time will entirely overcome. Gymnastics have been practised daily.

The case is interesting for several reasons: First, as to the etiology of the deformity. In looking up the subject, I find but little mention of it. In Holmes's *Surgery* (vol. iv. page 822, 1864) I find under the subject of dislocation of the shoulder, congenital: "Together with the anomalies of organization every form of congenital dislocation may be found; also without monstrosities, some irregularities occur, *which are sometimes treated as dislocations, but which are slight displacements through paralysis or muscular contraction.* Such are congenital dislocations of the shoulder. These are not true dislocations, but ordinary displacements, with paralysis, approximating, more or less, appearance to true dislocation, and perfectly reducible, to injury at birth."

"Bouvier, who reported Mr. Gaillard's case, considered that the dislocation was not truly congenital; but the result, he said, was extremely remarkable, the dislocation having existed for fifteen years. It cannot be doubted, on reading the case as given by Gaillard, that this lesion was not a true dislocation, but that the dispacement was due in the *first place to paralysis*, and which was doubtless subsequently *increased by muscular retraction.* The removal of such forms of paralysis and the consequent displacement is not so rare, and that a single fact of this nature should have been thought worthy of a place in the *Mémoires de l'Académie Royale de Médecine.* (Italics my own.)

Thus we see that Holmes attributes these displacements to paral-

ysis and subsequent muscular contraction and offers no operation for their relief.

An excellent article on the subject of congenital dislocation is to be found in Stimson's work on *Dislocations.* In the case reported by Gaillard he succeeded, after several attempts, in reducing the dislocation and keeping it in place.

This is all that I have found in looking over the literature on the subject of congenital dislocation underneath the spine of the scapula, and I have not yet found that any operation has been performed for its relief until the one I have just described, with the exception of Kürster's in 1882. Since this operation I have operated on two other cases for Dr. Leroy Hubbard, of New York, and the results in each case cannot be reported upon until more time has elapsed. The other two cases were operated upon in precisely the same manner as the one under consideration, and they will be reported later on.

Mr. Frederick Eve, F.R.C.S., Surgeon to the London Hospital, reported at the British Medical Association, August 1st, a case of a child of nine months, upon whom he had operated for congenital dislocation of the shoulder backward. The delivery had been with instruments, and paralysis of the arm was noticed on the following day. On admission movement was limited, and the head of the humerus was dislocated backward on the dorsum of the scapula. An operation was performed in which the deltoid was reflected and the capsule opened freely. The head of the humerus could not be replaced owing to its elongated and flattened shape, but after the part of the articular surface had been excised it was easily reduced. The wound healed quickly and in ten days' time the child was allowed to use the arm. Mobility was now almost equal to that of the other arm. There was no deformity of the glenoid cavity, and the irregular shape of the head of the humerus was obviously the result of its abnormal position.

In this case the same steps were followed that I reported upon at the Academy of Medicine in April.

In conclusion: From the fact that a fracture of the glenoid cavity was present in three cases upon which I have operated, and that the history of them shows difficult or instrumental labor, leads me to believe that these cases are not of paralytic origin, but are due to

traction made on the end of the bone either by the finger or vectis in the axilla. Paralysis may be present, being produced by injury at the same time; that paralysis is only a coincident, I have no doubt. The force applied in each of these three cases had torn away the posterior portion of the capsule, and with it a considerable portion of the glenoid cavity.

Stimson on *Dislocations*, page 271, says: "Congenital dislocations are very rare, and even in many of the reported cases there is much uncertainty as to the correctness of the diagnosis if we exclude from this class those cases in which a dislocation is produced during delivery. There are good reasons to think that cases are reported as congenital with no better reason for the opinion than the fact that the dislocation has been discovered at an early age, and that there is no history of a traumatic cause, consequently these may be and doubtless are included in traumatic cases occurring at the time of birth, and paralytic cases of infancy, especially the so-called 'obstetrical paralysis' (*vide infra*), and some doubt is thus cast upon the reported cases."

In cases of monstrosities and possibly rhachitis, no doubt a malformation of the glenoid cavity might exist similar to those in rare forms of congenital dislocation of the hip, but from the fact that I found the glenoid cavity injured in three cases, and in two of these the fragment was present and separated, but attached to the soft parts, leads me to believe that these cases are due to violence at childbirth and that the accoucher may often be responsible for them. I think, however, that inasmuch as the dislocation is produced before the child is born, they should be classified as congenital dislocations.

Up to the present time I know of but five operations having been performed for this deformity: One by Kürster in 1882, which resulted fatally; one by myself, in April, 1895; one by Mr. Eve, reported in August, 1895; two by myself, in November, 1895, to be reported upon later.

DISCUSSION.

Dr. V. P. Gibney. As I had a hand in this case, I must say that I think Dr. Phelps performed a wise operation, and I merely want to say that, as far as the case itself is concerned, it is a rarity. However, I think a number of us have seen similar cases from time to time. I can recall two or three in the last three or four years that I have been urging to have a similar operation performed. When the case came under my observation, and it was reported to me that Dr. Phelps had advised exposure of the joint and thorough curettement of the glenoid cavity, I at once said that I did not think it was practicable, for the reason that five or six years had elapsed since the head of the bone was out of place. The patient was eight or nine years old. In the first place, the glenoid cavity was shallow, and if he scraped away much material he would be sure to get ankylosis. So I was glad when the opportunity for consultation was offered, when we could discuss the matter freely. Dr. Phelps, Dr. Morris, and myself advised the course Dr. Phelps pursued; that is, to open the joint and simply do what was best under the circumstances. We advised removal of the offending portion of the head of the bone, and it was, of course, interesting to know if this was done. We could not get the arm in position and had to cut the fibrous attachment. The case when seen at a meeting of the Orthopedic Section of the New York Academy of Medicine was not in a condition to be handled, and I am sure we shall all be glad to get a later report. I am not quite prepared to assert, as Dr. Phelps does, that the case is practically a perfect cure. I do not know just how many adhesions there are about the joint, and how successful the patient will be in breaking these up. When we get a further report from Dr. Phelps of the case, it will be easy to add it to the report when published.

MENSURATION OF THE DEFORMITY OF HIP-DISEASE.

By A. B. JUDSON, M.D.,
NEW YORK.

The object of the present paper is to facilitate methods of recognizing, measuring, and recording the degrees of deformity of hip-disease. A great advance in the study of this subject was made in

Fig. 1.

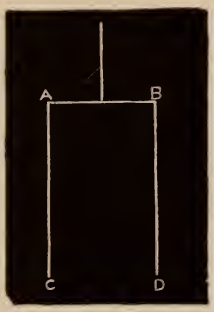


Fig. 2.

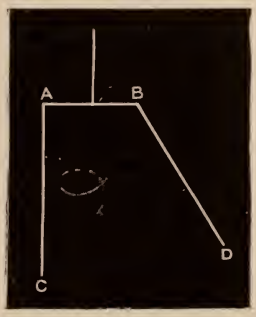


Fig. 3.

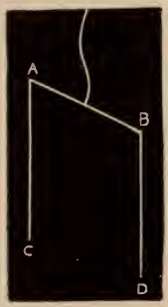


Fig. 4.

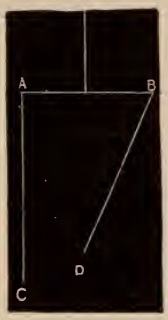
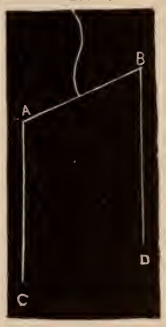


Fig. 5.



1877 by our Corresponding Member, Mr. Howard Marsh. I reproduce, in Figs. 1 to 5, the original figures with which he illus-

trated his first lecture on "Hip-disease" at the London Hospital for Sick Children. These figures, modified in various ways, have reappeared many times in the literature of this subject, and to one clinically familiar with these deformities they do not require explanation. Mr. Marsh's lecture contains a complete exposition of the mechanics of the deformity of hip-disease, and it will not be easy to add anything to what he has said.[1] I have, however, constructed the movable models represented in Figs. 6 to 10, in order to make this difficult subject more easy of comprehension.

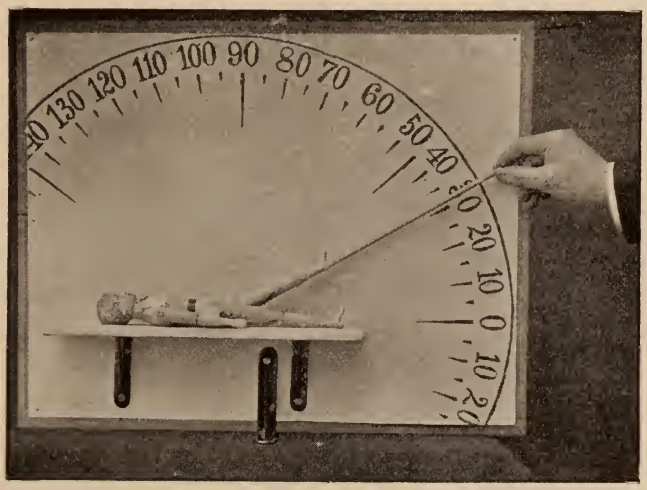
Fig. 6.

As seasoned practitioners we appreciate at a glance the clinical significance of abduction or adduction when combined with fixation. Abduction means apparent lengthening, and adduction apparent shortening. Abduction and lengthening, adduction and shortening, flexion and lordosis, are to us mentally interchangeable terms, but it may not have occurred to us all that these factors of deformity may be easily measured and recorded, and that we may thus better appreciate the importance of affording relief and the merits of what-

[1] British Medical Journal, July 14, 1877, pp. 37-39.

ever method we may adopt to remove or prevent deformity. The dolls, in Figs. 6 and 7, were arranged and photographed several years ago. They show graphically the degrees of motion and deformity, but they cannot, from the immobility of their vertebral joints, show the effects of the disease on the length of the limb and the curve of the spine. These effects are, however, shown in Figs. 8 to 10, in which figures cut out of press-board take the place of the dolls, and are so put together that they exhibit motion, and also the arrest of motion, not only at the hip, but also at the vertebral joints.

Fig. 7.



The figures explain themselves to a certain extent. The joints are made of eyelets not pressed too hard with the "eyelet-set," and loosely screwed to the board at V in the full figure, and at H in the profile. The piece representing the thorax in the profile is reinforced at the back by a thin sheet of brass, as the edges of the press-board were found to wear out against the four screws which act as guides. The spring clip is a "scarf-retainer." The apparatus is easily made, and is useful in class-demonstration.

To show the effect of lateral deviation with fixation: The full figure is first arranged symmetrically, as in Fig. 8. The clip applied at A binds together the piece representing the pelvis and that representing the trunk, and thus prevents motion in the verte-

bral joint, at V, while motion at the hip-joint is free. The limb is then drawn into adduction, as in Fig. 9, and the clip is removed

Fig. 8.

from A, releasing the vertebral joints, and applied at B, where it fixes the hip-joint at H, by binding together the pieces representing

Fig. 9.

the pelvis and the femur. When an attempt is then made to restore symmetry, or to make the limbs parallel, the figure exhibits tilting

of the pelvis and apparent shortening, as in Fig. 10. In like manner, abduction and fixation may be made to produce apparent lengthening. A fortunate result is that in which the patient recovers with enough apparent lengthening to annul the real shortening caused by loss of bone or unequal growth.

Fig. 10.

To show the effect of flexion with fixation: The cuts may be turned sideways so as to present the profile recumbent. The clip applied at A, as in Fig. 8, binds together the pieces representing the pelvis and the trunk, and thus prevents motion in the vertebral joints, V V, while in motion at the hip, at H, is free. The limb, is then raised in flexion, as in Fig. 9, and the clip is moved from A to B, releasing the vertical joints and fixing the hip-joint. When an attempt is then made to reduce flexion or lower the limb to the table, the result is lordosis, as in Fig. 10.

It is interesting to note, by observing the transverse dotted lines, that the patient's height is increased by either adduction or abduction, and decreased by flexion when either is combined with fixation. The height is diminished in lateral curvature of the spine by the sigmoid curve, in Pott's disease by kyphosis, and in hip-disease by lordosis.

The deformity of hip-disease may readily and with sufficient accuracy be measured by the use of the goniometer, two forms of

which are shown in Figs. 6 and 9. This instrument is simple in construction and may well be in frequent clinical use. The one shown in Fig. 9 is made by attaching arms to a protractor.

To measure adduction or abduction : The limb is slowly moved in the direction of adduction and abduction alternately until, after repeated trials, it is seen that when it is held at a certain point in the arc of lateral motion, the iliac spines are at right-angles with the axis of the trunk. One arm of the goniometer is then held parallel with a line connecting the iliac spines. If the table is against the wall of the room, it is convenient to see that the iliac spines are at right-angles with the wall, and then the arm of the goniometer may be directed point-blank at the wall. The other arm is then made to coincide with a line parallel, as near as may be, with the axis of the limb, which may, for this purpose, be considered to extend from the middle of Poupart's ligament to the middle of the heel. If the axis of the thigh only is considered, the incidental presence of the genu valgum or varum would impair the value of the observation. The degrees may then be counted on the scale of the protractor.

To measure fixation : With one hand the limb is slowly raised and lowered until, after repeated trials, it is found that, when the limb is held at a certain point, the lumbar spines press gently on the fingers of the other hand placed under the back. One arm of the goniometer is then held horizontally by the hand released from under the back, while the other arm is made to coincide, as near as may be, with a line parallel with the axis of the mass of the limb. The degrees then read off on the inner scale of the protractor are the degrees of flexion. Although its determinations are, from the nature of the case, only approximate, the goniometer is an instrument of precision, and as such finds a place in the consulting-room.

Writers on this subject have usually viewed deformity as the result of immobilization of the hip-joint. The figures and models referred to in the preceding pages have been constructed with that view. As a matter of fact, however, few cases present absolutely immovable joints at any stage. There is almost always considerable motion. In the acute stage the joint, which at the first glance appears to be motionless, is found to yield through an arc of many

degrees in response to gentle force rightly applied. Later in the course of the disease many cases show wide and free passive motion in different directions, and the point at which motion is arrested often varies from day to day. And even in after-life the position of the limb is subject to considerable variation. The use of the goniometer facilitates recognition of these phenomena. Further observation in this direction may add to our knowledge of pathology and skill in treatment.

PIGEON-TOE.

By JAMES E. MOORE M.D.,
MINNEAPOLIS.

Toeing inward is not always a disabling deformity, but it is very unsightly, and parents are always anxious to have their children relieved of it. It may be caused by habit, by knock-knee, and by talipes.

When due to habit it can be overcome by education alone when the patient arrives at a proper age. It is good practice in these cases, however, to elevate slightly the outside of the sole of the shoe.

The majority of cases of pigeon-toe, where there is no club-foot, are due to knock-knee. The knee-deformity is very often so slight that it has been entirely overlooked by the parents and family physician. It is very rarely indeed, in my experience, that it is possible to make the inner condyles and the internal malleolus touch at the same time in a pigeon-toed child, while the limbs are extended. The child naturally turns its toes inward to relieve the bending inward and consequent pain at the knee. This variety of pigeon-toe is best relieved by knock-knee braces, extending from a waistband to the soles of the shoes. The shoes should be attached to the braces toeing outward. The waistband should be made in two pieces connected front and back by buckles. By tightening the back buckle the toes will be pulled outward. It is often of advantage to elevate the outer side of the sole of the shoe slightly in these cases.

With this treatment in this class of cases the prognosis is always good. When the knock-knee is cured the pigeon-toe has disappeared.

We understand that this variety of pigeon-toe is only a symptom

of knock-knee, but it is frequently so much more noticeable than the primary trouble that I thought it would be of advantage to study the subject from this point of view.

That variety of pigeon-toe due to talipes equino-varus is the one most difficult to treat, and the only one in my experience which sometimes fails to yield to the plan of treatment advised for the last-mentioned variety.

Fig. 1.

When the talipes is completely cured, the pigeon-toe will gradually disappear in the vast majority of cases, with the growth of the child, without treatment. The majority of cases in this class requiring treatment will yield to the treatment recommended for the knock-knee cases, but a certain number still remain that cannot be successfully treated in this way. The following case, I believe, is a representative one of this class.

The patient was a boy two and one-half years old, who was born with single talipes equino-varus. The case was a very bad one at first, and had, of course, grown much worse during the year and a half that the child had walked upon the foot. I performed a Phelps's operation and got a very satisfactory result so far as the talipes was concerned, but there was very marked toeing-in.

Fig. 2.

I was obliged to have the first photograph taken before the wound was perfectly healed, and, therefore, with a bandage on, because the child had been brought to me from a distance and could only remain the minimum length of time necessary to bring about a cure, but it shows the deformity in a fairly satisfactory manner. I was satisfied that this case was one in which the pigeon-toe would be persistent because, when he stood flat upon the bottom of both feet with the knees looking directly forward, the inner malleolus looked

almost backward. The deformity was due to a twisting inward of the shaft of the tibia. The crest of the tibia, instead of passing down the median line in front, gradually swerved toward the inner side. This twisting of the tibia is, I am satisfied, the most important part of the deformity in these persistent cases of toeing in.

It was so evident in this case that the deformity was in the tibia, that I very naturally thought of treating it by an osteotomy, just as is so often done for other deformities of this kind.

In June, 1894, at the Northwestern Hospital, I performed a linear oseotomy and rotated the lower fragment upon its longitiudinal axis until the foot was in a position corresponding to the other one, and a plaster cast applied. The fibula was not touched. The result is shown in Fig. 2.

A letter recently received from the mother states that the boy walks so perfectly that one would not suspect that he had ever had a deformity. Upon looking up this subject since, I have been unable to find any report of a similar operation. While the cases requiring it are necessarily very few, it certainly meets the requirements perfectly.

A CASE OF UNUSUAL CONGENITAL DEFORMITY.

By E. MUIRHEAD LITTLE, F.R.C.S. Eng.,
LONDON, ENGLAND.

J. W. H., male, aged nine years, was admitted to the National Orthopedic Hospital in July, 1893, suffering from deformity of the left foot. His mother says that at birth the foot was only slightly twisted inward, but that it was noticeable. She is sure

Fig. 1.

On admission.

that there was no difference between the length of the two limbs. She had no accident during pregnancy. The labor lasted twenty-four hours, but was otherwise normal. She has no other children.

Family history negative. Patient was operated on six times when about three months old, with benefit, but relapsed.

When three years old he had three-quarters of an inch added to the left boot. At five years of age he needed two inches. Between five and seven years of age it is said that there was no increase of inequality of length of the two limbs. Since then the increase has been steady.

State on admission: Patient is an intelligent lad, pale but apparently healthy, of fair complexion. His left foot is in a position resembling somewhat talipes equino-varus, and presents the appearance shown in Figs. 1 and 2. The limb is three and a half

Fig. 2.

On admission.

inches shorter than its fellow. The thighs are of equal length, however. The ends of the leg-bones appear much wider than on the right side; this is partly real widening (three-quarters of an inch) and partly apparent, owing to the left foot being smaller and narrower than the right one. The width at the malleolus, measured by means of a shoemaker's measure, was, on the right (normal) side, two and one-eighth inches; on the left (deformed) side,

two and one-half inches. There is great prominence of the outer malleolus, most marked when the foot is inverted, and this bone is obviously overgrown. On everting the foot as far as possible the internal malleolus can be easily felt beneath the skin, and an interval is evident below it and between it and the astragalus.

The heel is drawn upward and inward, and the sole of the foot is contracted and looks, when the patient is erect, inward and downward. Attempts were made by tenotomy, wrenching, and Scarpa's shoe to rectify the deformity, but it became evident that the size and shape and position of the external malleolus resisted rectification.

Fig. 3.

After excision.

Having regard to the great disproportion between the limbs, and its probable increase, I advised the parents to allow me to amputate the foot, believing it would be a worse than useless appendage on his reaching maturity. As they, however, refused to consent to this, excision of the ankle was agreed upon.

I much regret, both for the boy's sake and this Society's, that my advice was not followed, for amputation then would have saved him a subsequent operation, and would have afforded us a far more interesting specimen.

On October 25th I removed the lower end of the fibula and then the internal malleolus, and no more than absolutely necessary of the main articular surface of the tibia. A thin slice was also removed from the trochlear surface of the astragalus.

The inner malleolus proved to be represented by an almost globular knob something like a miniature caput femoris, having a distinct neck of some length. The globular portion was covered with cartilage, but appeared not to articulate with any other bones.

Fig. 4.

After excision.

The main articular surface was very oblique, looking downward and inward, and a good deal of bone had to be removed toward the outer side, in order to put the foot in good position.

The wound healed quickly and uneventfully, but bony union did not result. This I regret. The boy left the hospital with a movable joint. His feet then presented the appearance shown in Figs. 3 and 4. The malleoli removed are shown in approximately relative positions in Fig. 5, two-thirds of the actual size, and by the accompanying plaster *fac similes* of the originals.

On January 9, 1894, the patient presented himself for inspection, when the following measurements were taken :

Right fibula, ten and three-quarters inches long. Remains of left fibula, seven and one-quarter inches long. Length from anterior superior spine of ileum to upper edge of external condyle of femur, thirteen inches on each side. Length from the same point to the sole-level of foot: on the right side twenty-seven inches, on the left twenty-three inches. Length from heel to end of great toe: on the right side eight inches, on the left seven inches.

Fig. 5.

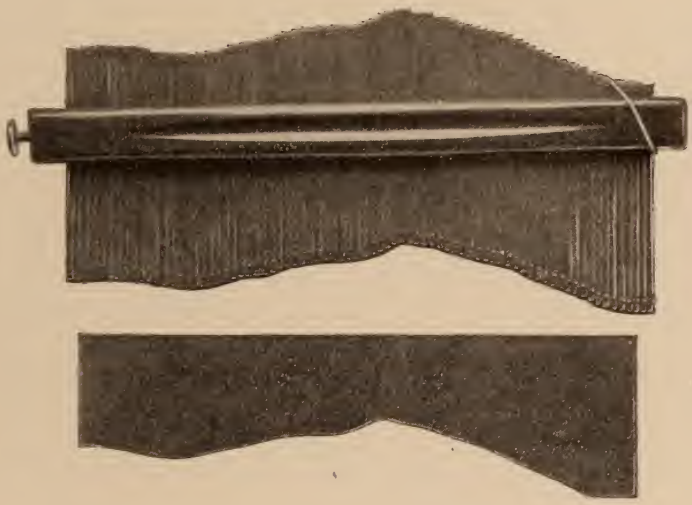
Relative (approximate) position of the bones removed (two-thirds actual size).

The cause of this deformity appears to have affected mostly the diaphysis of the tibia, and in a less degree of the fibula; but the lower epiphysis was also affected, as shown by the abnormally large size (almost full grown) of the lower end of the fibula and the peculiar formation of that of the tibia. I am unable to offer any explanation of this condition, and await with anticipatory pleasure the comments of members of the Society. It appears, however, to me that possibly the form of the internal malleolus was partly determined by the absence of pressure below through the astragalus. The tibia is, perhaps, the most constant bone in the vertebrate skeleton, and varies less from a presumed primitive type among the different mammals than any other bone. In none of them, as far as I am aware, has it a pedunculated process at its inner lower extremity.

A DEVICE FOR SPINAL TRACINGS.

By ERNEST B. YOUNG, M D.,
BOSTON.

The taking of spinal tracings with the lead-strip in a hospital where many cases of spinal caries are treated is a very laborious and time-consuming task under the best of circumstances.



If the strip is so pliable as to allow of easy adjustment to the back, its shape is almost sure to be changed during removal; and if stiff enough to avoid this accident, it requires much time and patience to fit it, especially if the child is at all nervous or unruly.

The device which I am about to describe has had a trial of eight months at the Children's Hospital in Boston, and has proved very satisfactory.

The tracer consists of a piece of mahogany two by two and one-half inches and twenty-two and one-half inches long, with a slot cut in it twenty inches long. In this slot a number of pins, three-quarters by three-eighths inches and eight inches long, play freely up and down. At one end is a thumb-screw which, when set up, holds the pins firmly in whatever position they may be in at the time.

The method of taking the tracing is very simple. The child lies on its face and the ends of the pins are placed on the spine, the piece containing the pins being held in the hand and moved up or down as the deformity may require.

The tops of the pins should be gently tapped until all rest evenly; then the thumb-screw should be set and the tracer removed.

To transfer the tracing, lay the tracer flat on a piece of cardboard and with a sharp pencil mark around the ends of the pins. This gives a line made up of small scallops. Cut through the highest or most prominent part of each scallop, and, if properly taken, the tracing will accurately fit the back.

For private use the tracer could be made much lighter than the one I describe, and could also be made of aluminum.

A CONTRIBUTION TO PATHOLOGICAL ANATOMY OF THE CONGENITAL DISLOCATION OF THE HIP, AND TO ITS TREATMENT.

By M. BILHAUT, M.D.,
PARIS, FRANCE.

Gentlemen: You have greatly honored me by naming me a Corresponding Member of the American Orthopedic Association. I shall show my thankfulness by dedicating to you this work. May it prove that the one you have elected is not unworthy of your choice.

Congenital dislocation of the hip is an affection which, in all times, has attracted more especially the attention of orthopedic surgeons. In the last few years we have seen marked radical advances in the treatment of this affection, as witness the radical operations of Drs. Albert Hoffa and Lorenz and of Dr. Paci. In their respective countries, Drs. Hoffa and Lorenz are the advocates of the surgical treatment, and already the statistics published by them contain gratifying results of this method.

In France, this question has been studied with much interest, and recently the Pædiatric Meeting in Bordeaux took up this subject as one of the questions coming within its legitimate sphere of usefulness.

I was present at this meeting. I took an active part in the discussion, and the following opinions, including my own, were then expressed.

Etiology. Although there is practically unanimity as to the definition of congenital dislocation of the hip, yet opinions as to the etiology of this affection vary much

The situation of the fœtus during intrauterine life, accidents to

the mother, too great or too small quantity of amniotic liquid, etc., are causes difficult to recognize. May we believe, as Jules Guerin did, and as Lannelongue seems to suppose, that medullary troubles are foremost in causing this affection? May we consider that a transitory hydrorrhachis is its exciting cause? These are theoretic views not confirmed by anatomical facts, and which remain for the present hypothetical.

Heredity plays an important part in the genesis of congenital dislocation of the hip. That is certain. Many patients are children of parents afflicted with the same affection; but this gives us neither the secret of the manner in which this inheritance takes place nor of its anatomo-pathological development. Prof. Lannelongue told us recently that the laws governing the development of the pelvis, being very different in the two sexes, it seemed to him possible to see in this an explanation of the greater frequency of congenital dislocation among women. Undoubtedly, woman's pelvis differs very much from man's, in respect to its internal dimensions.

Verneuil's opinion is not to be adopted. He attributed congenital dislocation of the hip to paralysis of the gluteal muscle. This is a mistake, and when the muscle seems thinner it is caused by the absence of several of its fasciæ. The remaining fasciæ have an absolutely normal development, and when examined with the microscope present no difference in the healthy. Besides, galvanization shows their normal contractibility. Reaction of degeneration is never found.

Finally, our present knowledge of the etiology of congenital dislocation of the hip is very incomplete and does not allow us to state why, without heredity, any particular child more than another is afflicted with this calamity.

Pathological Anatomy. The pathological anatomy of congenital dislocation of the hip is all-important to know. It is through knowledge of the most frequent changes that the principles of proper treatment are to be found.

The dislocation has not always the same direction, and if the cases in which the femur puts itself into the external iliac hole are the more frequently observed, it is proper to notice the upward, downward, and forward dislocations.

I cannot describe the conditions met in each of these particular cases, because I did not have an opportunity to find such material in the dissection-amphitheatre. I content myself by making use of the researches made on an anatomical specimen concerning the congenital dislocation that I showed, a month ago, to the Pædiatric Meeting in Bordeaux, and the photographs of which I exhibit. In the specimen above mentioned I found alterations of muscles, bones, and ligaments.

FIG. 1.

FIG. 2.

MUSCLES. The direction of the fasciæ of the great gluteal muscle is considerably modified according to the abnormal height of its movable insertions which has followed the ascension of the femur. Consequently the superior fasciæ are less obliquely directed downward and the inferior fasciæ more outward and forward. The mean gluteal muscle, raised by the head of the femur, shows no trace of

retraction or shortening. The minimal gluteal muscle, concealing entirely the head of the femur and its capsule, is manifestly lengthened. Its internal side, which ordinarily adheres loosely to the capsule, is here so strongly tied with it that I did not succeed in separating them in the dissection. I shall refer shortly to a peculiarity observed in this place. In the posterior region the deep muscles are not less interesting. The pyramidal is directed transversely from the inside outward. One of the twins is missing;

FIG. 3.

FIG. 4.

the other, as also the internal obturator, is directed upward and outward. The crural square, evidently transverse, is directed here obliquely upward and outward. These muscles after they are dissected—*i. e.*, rid of their aponeurotic envelope—seem not too short for a reinstatement of the head of the femur in the capsule. But, on the right limb, when I had performed the operation, these

muscles formed a compact heap, and I thought necessary to disintegrate them to make more surely the reduction.

Forward and inward the femur, the internal obturator, the pectineus, the adductors, the tensor fasciæ latæ, and the quadriceps have their ordinary direction. The psoas iliac is firmly tied with the capsule, and, instead of being situated before, runs across in the inferior part. In the muscular interstices a notable quantity of fatty cellular tissue is to be found. The form of the capsule is ampullar; its superior part is large, contains the head of the femur, and forms a rather round prominence movable with the head. The capsule is thickened in all its dimensions, and particularly in the interior and internal parts, where large fibrinous bundles stretch themselves when the femur is abducted. Observe, the capsule is tied with the minimal gluteal muscle, which itself is much thinned; the capsule is very intimately united with the psoas iliac. By opening the capsule we observe that its femoral insertions are normal. As for the condyle, nothing particular is to be found, but above its insertion is drawn back beyond the cotyloid eyebrow and swelling, which are dulled in this place. At a distance of about an inch from the capsule and above it, we find a prominence as large as a shilling, covered with fibrinous tissue, consisting of fasciæ crossing each other in several directions. Under them we perceive the small embossing of the right anterior tendon and its sheath. Around this prominence the connective tissue has formed a kind of secondary capsule.

The head of the femur communicates, in fact, with this prominence, not directly, but by means of the superior part of the capsule, which, during the ascension of the head, comes between the iliac bone and the femur. Between the capsule and the bone is to be found a small quantity of serous tissue. There is no true new joint. The ligamentum teres is present, but thin, lengthened, vermiform, with normal insertions. The two fasciæ of Bertin's ligament not prominent. The capsule is relatively large, and without the prominence formed behind by the cotyloid pad it should contain the head. Nevertheless, it has not the normal round shape. The head of the femur is rather less unfolded; its shape is not regularly spherical, but sensibly flattened before and behind. The head is well connected with a sufficient length of neck, and, in such a case, it

should not be necessary, after reduction, to hold the limb in inward rotation, as in other cases. The reduction is difficult to obtain, and when attempted difficult to maintain, because bodies outleap which separate the false and the true cotyles, and produce a projection of the head. In the present case, the pelvi-trochanter muscles oppose no obstacles to the reduction. Generally this opposition comes from :

1. The hard tension of the psoas muscle, of adductors, and particularly of the superior fascia of the great adductor during the attempt made to keep the head down.

2. From the opposition and tension of the inferior part of the capsule.

This last obstacle was not yet described, and, while Hoffa speaks of the resistance made by the anterior part of the capsule, you can convince yourselves that it is only at the *inferior* part that this resistance is to be found. I always found it there in the bloody reductions I made, and as long as it was not sectioned.

As you see, gentlemen, the difficulties in reducing the femur in cases of congenital dislocation of the hip are of many kinds. It is of great importance to know then when it is needful to interfere by another way than by manipulations.

The lesions I found in this specimen are of interest because they do not confirm the common opinion on disintegration of the capsule and formation of a new joint as perfect as possible in the place where lies the head of the femur. Here the capsular insertions are normal, and we do not find the wallet—or sand-box—disposition I met the first time I made an operation on such a case. The artificial communication made during the dissection between the capsule and the closed cavity lying under the minimal gluteal muscle should not deceive you, and you can convince yourselves that its constituent elements are essentially different from the normal capsule. Although we have here an old case, since the patient was ten years old and afflicted with lameness as soon as he walked, do you not think a small effort was sufficient to get a good result?

To-day the soft parts have lost some of their bulk, and that is sufficient to allow the reduction. Is not the idea of the surgical cure of congenital dislocation a seductive one? You easily understand that in such cases a slight regularization of the capsule with a little thinness of the head allows the solution of the problem.

Such were the hopes and results obtained by Hoffa and Lorenz. Such also are the results I got several times. You can judge the modification produced by the treatment on the patient whose photographs I have the honor to show you. These photographs were taken before intervention, the others only some days ago, about two years after I practised the double operation, and consequently at a time when the results are definitive. This child was afflicted with a congenital dislocation of the hip; he had then a lumbar saddle that the photographs do not show sufficiently well because my photographic service was then not so good as now. The latest photographs shows instead of a little, weak, and pitiful child, a well-muscled and developed boy, with a good gait and who walks, jumps and *swims* as well as his companions; so well cured that he can become a good soldier. With him I proceeded as follows:

After he was submitted for weeks to forcible extension, I tried, under chloroform, to reduce the luxation by observing the rules concerning the iliac luxation. My efforts were fruitless, and a few days after, June 7, 1893, I practised on the left side Hoffa's operation. I operated on the right side October 8th, of the same year. The recovery was rapid. This boy belongs to a family of workmen; his parents are doorkeepers in the Ivry. As they saw him unable to perform the least errand or to raise the least weight, and as he was not able to earn his bread as a caligraph, a drawer, a writer, etc., they foresaw the most unhappy life for him. To-day their son is a ceramister; he works standing, can stand fatigue, and is able to earn his living.

It may be objected that the operation does not always give such good results, and that there are cases in which the shortness of the neck, the atrophy of the head, do not allow such perfect results. That is possible, but there are cases, too, in which it is not necessary to have recourse to so important surgical means.

I have, among my cases, examples confirming this last assertion. In a little girl, three years old, afflicted with unilateral congenital dislocation of the hip, by simple manipulations under chloroform I effected a reduction without relapse. This girl is now six years old; she has recovered all the movements of the hip, and no elevation of the great trochanter above Nélaton's line is to be found. She was recumbent for four months in a plaster-of-

Paris apparatus, and afterward was submitted to forcible extension as well as to manipulations. A week ago I got another perfect reduction in a little girl six and a half years old. The assistants saw the projections of the head by coming into the capsule and heard the noise characteristic of the reduction. The result I obtained is too recent to consider definitive, but it may be said that if the reduction were not perfect it should shorten the capsule.

TREATMENT. I think, gentlemen, that previous indications are to be received, facts to be co-ordinated, and operations to be well regulated. As for myself, I think the reduction may be attempted as soon as the diagnosis is made certain. I think that the number of good results would increase if operations took place sooner than at present. The patients risk nothing, and, if the attempts at reduction are in vain, it is to be supposed that there are modifications which prevent coaptation. This presumption should increase after applying the forcible extension without results. In these rebellious cases it remains only to employ temporary orthopedic apparatus or to resort to surgical treatment.

As to treatment, all is not yet said, and I cannot consider as definitive the method of Hoffa and Lorenz. Besides, my object is not to study to-day surgical treatment of congenital dislocation of the hip, but to show its possibility. I shall study it later.

I ought, therefore, to give my opinion on the ultimate consequences of forcible reduction, because it may be objected that the premature ossification of the condyle and consequently its imperfect development perhaps determine a new dislocation, especially when the head of the femur continues to develop. I content myself by translating what Hoffa says on the subject in a memoir very recently published and concerning 112 cases :

"The chief question for us to know is the solidity of the new-formed articulation. I know that after intervention or with time and growth of the child, and though the hip has well worked at first, are relapses not frequent? With my six years' experience I can answer, *no*. Only three times I observed a new dislocation, and it was in children who, at the wish of their parents, came out of the clinic immediately after cicatrization. I never saw a well-operated and fixed hip give way to a new backward dislocation. Undoubtedly the head of the femur and the capsule

grow simultaneously, and the operated limb, instead of stopping in its growth, develops itself in the same time as the other."[1]

Years ago, gentlemen, the only treatment of hernia consisted in wearing a bandage. The surgical treatment was only applied to cases complicated with contraction. Now the demonstration is made; it is perfect, and the surgical treatment of simple hernia is a common operation. It will be so with the surgical cure of congenital dislocation of the hip. The publication of more numerous facts will determine the data of pathological anatomy and will not leave orthopedic surgery powerless.

Conclusions. While the diagnosis of congenital dislocation of the hip is generally easy, we are far from understanding clearly the etiology of this malformation. Nevertheless, we know that a disproportion between the capsule and the head of the femur is its most frequent cause, and that generally the former is too narrow to contain the latter. Commonly, the head of the femur is well developed, but is frequently connected with a too short neck.

We observe also a modification of the muscles, the insertions of which are modified, especially the movable ones. The muscular fasciæ are not paralyzed: galvanization proves it. In trying reduction by manipulation, with or without surgical intervention, the difficulty to keep down the superior extremity of the femur is caused less by the pelvi-trochanter muscles than by the psoas iliac, and from a fibrinous thicker lap that is to be found in the inferior part of the capsule and running parallel to Bertin's ligament. As to the treatment, it is logical to proceed gradually.

1. As soon as the diagnosis is certain, and as early as possible, resort to manual reduction. It is by such means that coaptation is the more surely obtained. Apply after this a plaster-of-Paris jacket; prescribe a four months' immobilization, and renew the apparatus when necessary.

2. In case of failure resort to forcible extension with weights, and take care to maintain the patient in the recumbent position and to place the member in abduction. After many weeks' extension

[1] Die Endresultate der Operationen der angeborenen Hüftgelenksverrenkungen. Berliner Klinik, 1895.

the elongation of the muscles is sufficient, and the manual reduction should be attempted under chloroform.

3. If the head of the femur can be reduced, but cannot be held in a good position, it is necessary to interfere surgically, and to favor coaptation by increasing the dimensions of the capsule.

4. When the head of the femur has a bad direction, it is convenient to make the reduction to secure its maintenance, and to make posteriorly an under-trochanter osteotomy for correcting the deviation.

5. If the forcible extension does not allow the keeping down of the head of the femur in front of the capsule, it is necessary to resort to surgical intervention, and to section the limbs in apposition with the reduction. This should increase, when necessary, the capsule and give the head of the femur a shape as near as possible to that needed for the good working of the articulation.

6. Reduce the dimensions of the capsule.

7. In cases where the head of the femur is united with the superior end of the diaphysis of the femur, without being sustained by a neck; in these where the head of the femur misses, by an arrest in the development, the surgical treatment of congenital dislocation of the hip is contraindicated.

IDIOPATHIC OSTEOPSATHYROSIS.

By WALLACE BLANCHARD, M.D.,
CHICAGO.

It is quite certain that idiopathic bone-fragility is of much more frequent occurrence than has been supposed, though the literature on the subject is exceedingly meagre, and very little is known of its etiology.

Dr. Herman Tillmans, of Leipzig, in his recent work on the *Principles of Surgery and Surgical Pathology*, says of the idiopathic form of bone-fragility, that "its etiology is as yet completely unknown;" that "there are no gross changes found in the bones;" and that "the most probable cause of this disturbance of the nutrition of the bones is a change in the composition of their ground-substance."

When at the seventh session of this Association, held in September, 1894, I reported a case of fragility in a girl that had between the first and eighteenth years exhibited one hundred and six broken bones, all contracted by injuries too slight to be called violence, I was much impressed with the number of unreported cases that were brought out in the discussion.

Drs. A. M. Phelps, A. E. Hoadley, Samuel Ketch, and H. A. Wilson reported cases nearly, if not quite, as well marked as the one that had been the subject of my paper. Dr. Newton H. Shaffer reported a case of fragility in a child with a club-foot, about one year old, in which, while endeavoring to overcome the resistance with a club-foot shoe, he had a fracture of a tibia just above the ankle-joint.

The possibility of this condition should be borne in mind in treating bow-legs and club-feet.

Imagine for a moment the case reported by Dr. Shaffer, removed

from that eminent surgeon and placed in the hands of a fairly successful man in a provincial town. The result must surely be a suit for malpractice, and the ruin of a man's good reputation, unless the case should develop other fractures rapidly enough to head off the action of the courts.

By the kindness of Dr. L. E. Frankenthal, of this city, I saw a case last June at the Michael Reese Hospital, of a woman, aged twenty-nine years, who from the second year of life had, up to that time, exhibited seventeen fractures of the long bones and two dislocations—one of the left hip, and the other of the right ankle-joint. In this case, as in my case of one hundred and six fractures, the patient had but a slight suggestion of the laceration and contusion that come with the fracture of a healthy bone, as well as the inflammation and congestion that usually accompany it; consequently, the patient suffered comparatively little pain. The process of union was tedious in the extreme. On removing the dressing at about the seventh or eighth week, the provisional bone uniting the fractured ends had about the firmness of the rubber in the pencil-mark eraser in common use; and two or three years were required to bring the union to desirable firmness. Usually, however, the dressings have been removed at the second or third month, and the new union being of too pliable a material to resist the contracting power of the muscles, a gradual malposition followed, reaching its greatest consummation a little more than a year from the time of fracture, and in a year or two following becoming comparatively firm in its vicious position.

In each case the displacement has been of the angular variety, the callus being of sufficient strength at the time the splints were removed to keep the fractured ends of the bone approximated.

Case third, of bone-fragility, is a girl four years of age, at the Home for Destitute Crippled Children, at Chicago.

When she was nearly two years old she fell from a rocking-chair, fracturing her right femur about the middle third of the shaft. The parents, being quite poor and with a large family of children, let this child lay on the bed for several months without any surgical attention, under the idea that the child had rheumatism following a bruise. About six months later Dr. Taggart, of this city, was called to attend the child with a fracture of the left femur at

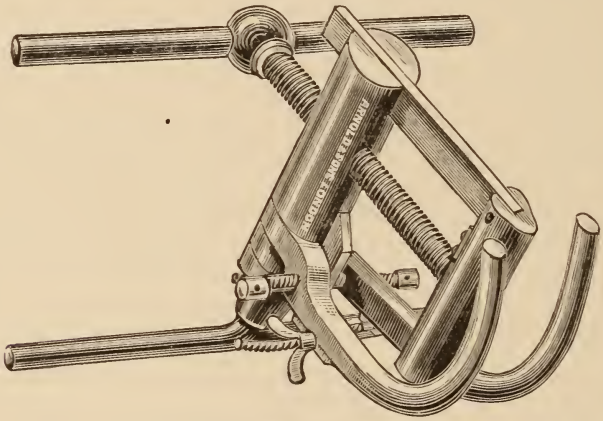
about its middle, which the parents recognized as such and saw the child contract it in slipping from a bed to the floor. Six months later Dr. W. M. Davis attended the child with a fracture of the left femur, about one and a half inches below the previous fracture. The union in both these fractures of the left femur was rapid and perfect, while the right femur exhibits its want of surgical attention with one and a half inches shortening, and a bending at the point of fracture of about thirty degrees.

In presenting this case of idiopathic bone-fragility I have been actuated by a desire to show the frequency of the condition, and in it a constantly underlying danger in the application of even slight manual force in the correction of deformities, and, also, that the condition should have more than passing consideration in its medico-legal aspects.

IMPROVED OSTEOCLAST.

By NICHOLAS GRATTAN, F.R.C.S.,
CORK, IRELAND.

The osteoclast described by me in the Transactions of the American Orthopedic Association, 1894, having been submitted to many severe tests by several of my friends, and also by myself, has been found sufficiently powerful to break any of the long bones, and it will also crush a large foot. After using it on several cases which required the application of great force, it proved to have two very troublesome defects: 1. The tendency of the cen-



Improved osteoclast.

tral pressure-bar to slip off of convex surfaces, either to the right or left, and change its position (lateral slipping). 2. From constant screwing and unscrewing the transverse-bar which rests on the table had a tendency to rotate, and thus upset the entire instrument.

On reading the remarks of my friend, Dr. Phelps, page 303 of the TRANSACTIONS, I determined to perfect this osteoclast, if possible, and after much thought I found that, without adding materially to its weight, lateral slipping of the pressure-bar could be prevented. A deep slot was cut in the spindle directly under the pressure-screw. Into this was inserted a strong, flat piece of steel, which projected forward and downward between the opposing bars. A set-screw exactly similar to the one in the right opposing bar was inserted to correspond with it in the left opposing bar. And both screws impinge against the piece of steel, projecting from the spindle.

By this expedient it has been found possible to regulate accurately the position of each opposing bar. And all three bars, pressure and opposing, can now be firmly locked, by means of the thumbscrew, in any desired position, and any lateral slipping of the bar is prevented.

With regard to its last defect, viz., the tendency of the transverse bar, which rests on the table, to unscrew. This has been easily obviated by means of a strong pin, which now secures this bar.

I regret that the additions made from time to time have greatly increased the expense of the instrument, which now costs, in my city, about forty dollars.

CONGENITAL LUXATION OF THE KNEE.

By HENRY LING TAYLOR, M.D.,
NEW YORK.

Congenital luxation of the knee is a rare affection, which is either altogether passed over or but briefly mentioned in most surgical treatises. Of 98 cases of congenital dislocation seen at Langenbeck's clinic, 90 were at the hip and 1 at the knee; and of 57 cases observed at the New York Orthopedic Dispensary, and reported by Drs. Ketch and Hubbard, 55 were at the hip and 1 at the knee. In a paper in the *Revue d'Orthopédie* for January, 1891, Phocas, of Lille, describes a case in detail, and gives a synopsis of 23 observations collected from medical literature, and Prof. J. Wolff, of Berlin, describes a case of multiple congenital dislocations, including luxations of both knees, in the *Zeitschrift für Orthopädische Chirurgie,* 1892, vol. ii., No. 1, and brings the number of recorded cases up to 29. In this country cases have been recorded by Bard, Youmans, Hamilton, Sayre, Myers, Gibney, Ketch, and others, of which Bard's, Youmans's, Hamilton's, Sayre's, and Myers's are included in Wolff's list.

Dr. Gibney's cases are reported in the *Archives of Pediatrics* for September, 1890. The first case had bilateral congenital luxation of the hips, of the tibiæ forward, and valgus position of the feet. When first seen, at four weeks of age, no patellæ could be made out. At three years of age the patient walked well, the knees could be flexed beyond 90 degrees, and the patellæ could be felt as small nodules. Dr. Gibney's second case was an infant with bilateral anterior dislocation of the tibiæ and recurvature of the knees, right pes equinus, left pes valgus, and rudimentary patellæ.

Dr. Ketch's case was a girl three years old, shown to the Orthopedic Section of the New York Academy of Medicine in 1889.

There was a right dislocation of the head of the tibia forward with eversion and genu valgum ; the ligaments were relaxed, especially the internal lateral, both at that time and when first seen at eighteen months.

In September, 1895, a female infant, five weeks old, was brought to Dr. Townsend's service at the Hospital for the Ruptured and Crippled, with club-hands, due to absence of the radii, and a peculiar congenital deformity of the left knee, consisting in an excessive genu varum with great laxity of the external lateral ligament of the knee, permitting a range of motion from 15 to 70 degrees of adduction, and with a tendency to backward displacement. The abnormality was not due to bending of the shafts of the femur or tibia, but was confined to the knee itself. Brief mention is made of the above case as it appears to belong to the congenital luxations of the knee.

The history of a case which was brought to me in May, 1888, will sufficiently illustrate the main points of the symptomatology. This was a boy, seven months old, the first-born of twins, in whom the peculiar condition of the knees was noticed immediately after birth. This baby's twin brother weighed seven pounds at birth, the same as my patient, and was perfectly formed ; there had been no deformity in the family so far as known. One child older than the twins and one born since are perfect in figure. My patient was a breechling, coming into the world with the thighs flexed upon the abdomen and the knees hyperextended, so that the feet lay at either side of the after-coming head. The malposition of the legs persisted after birth, and it was at once noticed that the knees were bent forward instead of backward, and that they could not be brought back –flexed—beyond a straight line, even by using considerable force. After being straightened in this way they would spring back into the abnormal position so soon as the pressure was removed. They readily bent forward to a right angle with the thigh, or 90 degres of hyperextension, and habitually remained at a considerable angle of hyperextension when left to themselves. The popliteal spaces were smooth and devoid of crease or wrinkle, but there were creases in front of the knee-joint, caused by the reversed bending of the knee. The thighs had been straightened down and kept extended by binding a board splint upon the baby anteriorly, and at the time of my examination were in normal position, as was

every part of the body except the knees. The hips were in place, the feet were perfect in form and function, and the spine, trunk, head, and upper extremities were normal in every particular. The knees remained constantly in hyperextension, that is, with the normal direction of bending reversed, and as the baby kicked from time to time the contraction of the quadriceps would increase the hyperextension, and at the same time draw the head of the tibia forward and rotate it outward. The knee was not observed to move in the direction of flexion. The knee-ligaments were much relaxed in all directions, permitting a lateral motion of 10° or more to either side. The right knee could easily be hyperextended 28° and the left 30°, while there were 22° of passive flexion beyond a straight line on the right side and 20° on the left, showing a greater range of motion in front of a straight line than back of it. In all positions the head of the tibia was displaced forward, and the femoral condyles projected prominently into the upper part of the popliteal space, which was smooth, the creasing being in front of the knee. The leg was somewhat everted at the knee. These displacements could be largely overcome by manual force owing to laxity of the ligaments, but immediately recurred so soon as pressure was removed. In all manipulations, however, the head of the tibia failed to slide back fully into its proper position. No rudiment of a patella was felt at this time, either by myself on repeated examinations or by several surgeons who had examined the case. At this time my patient measured R. A. and L. A., 10½; he weighed 19 pounds; and had cut five teeth. His brother measured R. A. and L. A., 11¼; he weighed 19½ pounds; and had cut six teeth. The treatment consisted in holding the knees at the limit of comfortable flexion and in as normal relation as possible, and in preventing lateral motion by means of light wire splints with proper strapping. After four months, hyperextension had diminished 8° on the right side and 2° on the left, while flexion had increased 68° on the right and 38° on the left. There was now considerable voluntary flexion; the joint-capsule was still very lax, and the knees were weak laterally.

Apparatus was now applied, which prevented lateral motion and any straightening of the knees beyond 150°, but flexion beyond this point was not checked. After one year of treatment the knees had

improved very much in strength, and there was but little hyperextension or lateral motion. Both knees could be flexed more than 90°; the right, which had always been the better, was still somewhat in advance of its mate. The patellæ could now be felt as very small nodules in the quadriceps tendon. The apparatus were now changed to permit free flexion through nearly the full range, hyperextension and lateral motion being checked. The patient reported in September, 1889, walking perfectly in his braces. He was able to walk much earlier, but it was thought prudent to hold him back until the knees were stronger. He was also able to walk equally well without braces, but this was not allowed except to demonstrate his ability, lest the weak ligaments should be unduly strained. The tibiæ were still somewhat displaced forward. In the fall of 1891, the children being three and one-half years old, my patient was forty-one inches tall, and his brother forty and one-half. The patient's patellæ were now well developed, measuring one and one-fourth by one and one-half inches, about one-eighth inch less than his brother's. This patient has continued to wear braces, preventing hyperextension and lateral motion at the knee, up to the present time. He is now eight years old, well grown, and somewhat larger and heavier than his brother. He is very active; in fact, the more active of the two. For a long time he has been able to walk perfectly well without his braces, and no abnormality in his gait or appearance is noticeable, either with or without the supports. Up to this time, in view of his great activity and heedlessness, it has been thought wiser for him to wear them as a protection; he leaves them off at night and for short periods in the daytime. Without the braces there are still a few degrees of passive hyperextension at the knee when, the patient being recumbent, the feet are lifted, but not more than is often observed in healthy children. There is passive flexion to 45° on the right side and 55° on the left; the range of active flexion is nearly as wide. There is slight lateral mobility and no noticeable deformity.

Adding this case with those of Drs. Gibney, Ketch, and Townsend to the 29 cases reported by Wolff, we have 34 recorded cases of congenital luxation of the knee, in 18 of which the deformity existed on both sides and in 16 on only one side. In 24 of the 34 cases the displacement of the tibia was anterior or prefemoral.

In at least 12 of the cases no patella was felt in the affected knees at birth, and for some time after; in 5 of the 12 it is noted that the patella could be felt as a small nodule in the course of a year or two. In only one case, reported by Carl Müller, was the absence of the patella anatomically demonstrated. As has already been stated, while a few cases of luxation in other directions have been observed, the large majority are of the tibia forward with hyperextension or recurvature of the knee. Of the prefemoral cases two types are described: one bilateral, of which a considerable number of the reported cases have been observed in fœtuses, stillborn children, and monsters, and which is usually associated with other congenital anomalies; the other type, unilateral, in otherwise perfectly formed children. The case detailed presents an exception to this rule; with a bilateral deformity of the knees the child was free from other defect. Phocas states that lateral mobility at the knee is the exception, and confined to the bilateral cases usually associated with other deformities. With the stretching which the lateral, as well as the other ligaments, must undergo to permit the excessive hyperextension and forward gliding of the tibia, lateral motion would be expected, and has been noted in many cases both bilateral and unilateral, abduction with eversion predominating.

As to etiology, a defect of development seems to be the probable explanation. There is no sufficient evidence that trauma, inflammation, or paralysis is answerable for the condition. Many of the cases have a history of breech-presentation, with the thigh flexed, legs extended, and feet applied to the head; it seems doubtful whether this position was assumed owing to the abnormal condition of the knees, or whether the knee-deformity was due to the abnormal presentation. The former view is strengthened by the numerous cases in which the knee-deformity is associated with other defects evidently due to abnormal or retarded development. Phocas's case as well as my own was the first-born of twins.

It is frequently stated in the books that the deformity in most cases has been readily corrected, and that the prognosis is good. As we have few records of cases under observation for any considerable time, and no reports tracing the subjects of this condition to adolescence or adult life, the ultimate result must be a matter of conjecture, but it is not unreasonable to suppose that a displacement

often difficult to reduce, with such a marked tendency to recurrence, and associated with such laxity in the ligamentous structure of the joints, cannot be safely left to itself, until it has been held and exercised in position and protected from undue strain for a considerable time. A number of cases have been reported in which a good result was obtained by either suddenly or progressively reducing the deformity and holding the knee by retentive apparatus so arranged as progressively to increase flexion. It seems to the writer advantageous to employ such means as will permit normal while preventing abnormal motion. Professor Wolff claims to be the pioneer in the operative reposition of a congenital luxation, having replaced, with a satisfactory result, a congenitally dislocated knee in a five-year-old girl in 1887, thus antedating Hoffa's operation on the hip. Phocas having found difficulty in replacing the knee dislocation in a young infant, was led to perform manual osteoclasis at the lower end of the femur in order to restore flexion, believing that the condition was not a true luxation, but a forward sliding of the femoral epiphysis. A good result is reported.

In the case detailed at the beginning of this paper attention is called to the twin pregnancy, the abnormal presentation, the bilateral luxation with recurvature, the lateral mobility, and the rudimentary patellæ in an otherwise perfectly formed child, and to the satisfactory condition and function of the legs and development of the patellæ to practically normal size after prolonged orthopedic treatment.

SPASMODIC WRY-NECK, WITH SPECIAL REFERENCE TO CONIUM AND ATROPINE IN ITS TREATMENT.

By T. HALSTED MYERS, M.D.,
NEW YORK.

This affection has been divided according to the anatomical distribution of the affected muscles; it has also been classified with reference to the character of the spasm present. These divisions, however, I shall not describe, since I do not intend to consider the surgical treatment, and the medical treatment is the same whether the spasm be clonic, or tonic, or intermittent.

I wish to call attention prominently to the fact that at the present time we do not know the cause of this spasmodic condition nor do we know the location of the lesion.

Examinations of the affected muscles have been made several times and reveal nothing characteristic. In some old cases there is simple hypertrophy from excessive exercise, and in others secondary changes in the nature of a fibroid degeneration of the ordinary type found where the origin and insertion of a muscle have been approximated for a long time from any cause. Examinations of the peripheral nerves supplying the affected muscles are also equally negative. There seems to be no pressure of an irritating nature exerted on these nerves in any part of their course external to the cord. We are, therefore, forced to the conclusion that the lesion must be other than peripheral. The curious anatomical distribution of the affected muscles would also tend to exclude disease of the peripheral nerves as the cause of the spasm. Whether the lesion is located in the cord, in the medulla, or in the basal ganglia, or in the cortex, however, is absolutely unknown. The character of the lesion, whether it is a degeneration, or a hypertrophy, or a

nutritional change, is unknown. The lesion has never been discovered by macroscopic or microscopic examination. From the clinical histories, it seems to be probable that it is a very fine, rather than gross change, and that it involves the medulla and cord between the origins of the spinal accessory and the fourth cervical nerves.

In the presence of this absolute lack of knowledge, empirical measures of treatment are eminently justified, and it is with the object of calling attention to the action of conium and atropine that I make this communication to this Association. The conium was given in larger doses than any I have seen recorded, and the atropine also in very large doses.

A thorough investigation of this affection, with details of cases, and reports on the pathological condition found in muscle, nerve, and cord, would, I feel, materially hasten the discovery of a rational method of treatment. Excision of nerves, while at times successful, and at present *the* most successful method of treating these cases, is at best uncertain, a serious operation, leaving unsightly scars, and, indeed, only a makeshift, since it attacks the effect rather than the cause.

In the first case which I wish to report, the young lady was twenty-four years of age when I first saw her. She had first noticed a slight tendency of her head to rotate ten years before; no cause for this was known. Three years ago this rotation, gradually increasing, had begun to annoy her considerably, and she noted that it was increased when strangers were present. Marked deformity, however, only occurred about seven months ago, and since that time the progress has been rapid, so that she has not felt like going into the street for the past five months.

The spasm seemed, according to her doctor, who is a good observer, to have started in the left sterno-mastoid. Both sternal and clavicular heads of this muscle were, therefore, divided with relief in April, but other more posterior muscles then seemed involved, and in June one and a quarter inches of the spinal accessory was excised and the levator anguli scapulæ, scalenus posticus, and splenius were divided. Relief followed this operation; but again the deformity relapsed, and she was referred to me.

She has a neuropathic family history, and is herself a rather

nervous girl. A strabismus of one year's duration was corrected two years ago. For three years she has had a rapid and irregular pulse (90 to 130), without any perceptible organic heart-lesion to account for it; it produces no unpleasant symptoms. Her general health is good, but she shows the effects of the five months' confinement and lack of exercise.

Her head is held by a clonic spasm of the muscles on the left side of her neck in the following position: Rotated to the right 30°, on a vertical axis; extended to the right 20°, on a transverse axis; flexed on left shoulder 40°, on an antero-posterior axis.

The spasm is intermittent to some degree, but is never altogether absent. During sleep there is no twitching if she lies on the left side of her head. While awake she keeps her left hand against the back part of her head on the left side, or her right hand against the right side of her chin. She can by a strong effort keep her head straight for thirty seconds, but cannot walk across the room or turn around without supporting her head. There is some tenderness in the old scars, and a tender point just to the right of the seventh cervical spine, and another in the left suboccipital region.

Believing that the condition of the general health was of great importance, and also judging that the constant, though perhaps at times unconscious, effort to keep the head straight was a great strain on the nervous energy of my patient, I constructed a brace to hold her head straight and so relieve her of this strain, at the same time making it possible for her to go about, walking and driving, without being conspicuous, as the brace itself could hardly be seen at all.

In view of several good reports on the use of fluid extract of conium in these cases, this drug was now given in steadily increasing doses. The first day, September 10, 1894, five drops were given t. i. d. Each day the amount was increased two drops.

On October 7th, after 52 drops were given, there was some interference with vision; "Everything danced before her eyes" for half an hour. Dose was diminished to 47 drops and then again increased steadily as before. On the 15th, after 53 drops, patient felt her legs weak if she walked. Noted some sharp shooting-pain in episternal region twice. On the 25th, in taking 75 drops t. i. d.,

the muscular spasm seemed less intense than at first. Cannot read for about an hour after taking conium.

On November 5th, taking 80 drops t. i. d. Has some nausea. Walked twice across the room and turned around both to the right and left twice without supporting the head. A considerable improvement over her condition at first. On the 8th, taking 80 drops t. i. d., since the effect may wear off between less frequent doses. A discouraging fact is noted: that she feels no difference in the spasm in the early morning when she is not under the drug, and in the evening after taking it all day. On the 15th, taking 94 drops t. i. d. Some nausea. On the 18th, taking 105 drops t. i. d., but there is little nausea. The doses are increased now more rapidly to get the constitutional effect, and to note then the effect on the spasm. On the 19th, 112 drops t. i. d. On the 20th, 120 drops t. i. d. On the 21st, 130 drops t. i. d. No nausea; spasm strong yet. On the 22d, 140 drops t. i. d. Weakness in legs felt ten minutes after the drug is taken; arms also weak, with slight numbness in arms and legs for an hour. On the 23d, 140 drops in the morning was followed by a chill; 145 drops at noon produced no symptoms; 150 drops at night made legs and arms very weak. On the 24th, 160 drops were taken at 9 and 11 A.M. and 3 P.M., and were followed by no more constitutional symptoms than the smaller doses. On the 25th, no conium taken. The muscular spasm was unchanged. She can hold her head straight about thirty seconds. Small clonic spasms are felt in the muscles, then a rest; the spasms and the interval of repose are each of about five seconds' duration. Head can readily be brought to a good position without aid of the hands. Conium treatment stopped as improvement was slight. The intensity of the muscular spasm has been diminished a little, but her improved hygienic conditions rendered possible by the brace might have done this. No dangerous or even serious constitutional symptoms were observed from these enormous doses.

Injections of an aqueous solution of sulphate of atropine were now made once a day into the muscles affected and into the painful points. Each point of injection was a little tender for a day, so different muscles were attacked on succeeding days; the splenius and trapezius and the upper part of the sterno-mastoid being especially selected, as the spasms seemed most intense in these mus-

cles. Deep injections were made many times into the deep rotators also. The quantity was steadily increased.

On November 25th, 4 drops of a solution (gr. j to the ℥j) were injected. On the 28th, six drops. Slight flushing of the face and dryness of the mouth for two hours; slight headache also; patient a little nervous.

On December 6th, 12 drops. Spasm is less immediately after the injection. Some nausea and vomiting. Patient is despondent. On the 8th, 8 drops of a double-strength solution (gr. ij to ℥j), as large injections are painful. Eyes much affected. Bones ache. Has much better control of her head after the injection. Walked round and round the room with head straight. Dryness persists from five to six hours. Patient could not read for the same length of time. On the 10th, 11 drops. Dreadfully depressed, though the spasm is less. She cannot shake off the feeling of despondency. On the 12th, 6½ drops of double-strength solution (gr. iv to ℥j). Very despondent. Dreams a great deal. Cannot keep awake, cannot read, dryness intolerable. Spasms about *nil* after the injection, but eight hours later returns and seems unchanged. Nausea seven hours after injection. Last dose, gr. $\frac{1}{18}$ atropine. On the 15th the feeling of depression had passed off, but the spasm has returned with almost its original force. The patient so dreads the despondent feeling produced that she refuses to go on with the drug, and I do not feel justified in urging it, since the effect on the spasm is so transient. For several hours after the injection the spasm almost disappeared. The effect of atropine is evidently much greater on this disease than that of conium, but unfortunately was not permanent in this case. My second case is as recorded below. Especial care was taken in both these cases to get a fresh supply of fluidextract of conium in a large quantity, to keep the bottle sealed, and for this patient's sole use. In this way we avoided decreasing the doses for safety when a new prescription was filled. In one case, however, this precaution (adopted for the first dose) proved useful, see August 16th.

M. P., aged twenty-one years, July 31, 1893, first noted a stiffness of the neck four and a half months ago. There is pain just below the occiput, at times severe. She is anæmic. Eyeballs are slightly prominent, but there are no symptoms of exophthalmos.

Patient does not seem to be of a nervous temperament. She has been treated by liniments and had galvanism several times. This hyper-corrected the position of her head, but was very painful, and the relief was not permanent. She now carries her head thrust forward, somewhat extended, and with the chin rotated to the left.

There is no disease of the spine or other apparent irritating cause. Rotation to the right is limited by spasm. Flexion, extension, and rotation to the left are quite free, but not quite normal.

On September 6th, fluidextract of conium, 4 drops t. i. d. On the 13th, fluidextract of conium, 5 drops t. i. d.

On December 8th, spinal assistant-brace and chin-piece applied.

On February 6, 1894, now taking fluidextract of conium, 11 drops t. i. d. No constitutional effects noted. Increase one drop each dose.

March 6th, 9 drops t. i. d. taken. No symptoms. Spasm seems most marked in left trapezius. On the 15th, 38 drops t. i. d. No symptoms. Spasm less. On the 27th, marked improvement since the 24th; was then taking 47 drops. Can now hold head straight without aid of chin-piece, and move it somewhat without bringing on the spasm.

On April 5th, 59 drops t. i. d. Much better control of head. Can hold it in a good position unaided for several minutes. On the 10th, 64 drops t. i. d. Feels a little nausea.

May 1st, 79 drops t. i. d. No symptoms. On the 29th, 94 drops t. i. d. Still a good deal of spasm.

On July 10th, 100 drops t. i. d. No symptoms.

On August 16th, 50 drops caused symptoms of nausea, weakness in legs, etc. First dose of a new supply of conium.

On November 20th, has been laid up two weeks with facial erysipelas; in bed a good deal of the time, and conium was stopped; now take 50 drops again, and Fowler's solution 2 drops t. i. d.

On December 4th, take 60 drops t. i. d., and increase 5 drops daily in each dose. Increase Fowler's solution to 5 drops t. i. d. Head is very rigid. On the 13th, spasm less strong. Increase conium to 95 drops t. i. d. On the 18th, spasms notably better for two weeks. On the 22d, make conium 130 drops t. i. d. Spasm less severe.

On January 3, 1895, increase 5 drops a day to 150 drops. On the 12th, walked easily about the room for several times, and head was held easily (not perfectly). Make conium 160 drops and Fowler's solution 7 drops. On the 19th, make it 170 drops. Head not so easily held as last week. On the 31st, increase to 180 drops.

On February 14th, all her friends who have not seen her for some time say she is much better. Is taking 180 drops without constitutional symptoms. General health fair. Increase dose to 190 drops. On the 26th, make dose 200 drops. This was kept up for several days without bad effects, and without more effect on the spasm than was seen after the 47-drop dose. Patient is discouraged and conium is stopped.

On April 4th, muscular spasm is neither greater nor less since conium was stopped. The spasm seems chiefly in the left trapezius, not on the right side at all. There is a tender spot one inch behind and one inch below the mastoid process on the left.

On September 14th, patient has been taking Fowler's solution and Blaud's pills and massage since April. She has worn brace all through her treatment. There is no pain now. Chin is a little to right of median line, and head inclines to the left. She can herself, without help, correct the position of her head, which was an impossibility a year ago. She can go out of doors and about without attracting attention. The use of conium in this case, as in the first, seemed a failure.

Both these cases, however, were steadily growing worse when they came to me. This advance has been stopped, and both are decidedly better than they were when first seen. We cannot ascribe this change to the conium nor to the atropine, since the effect produced by the latter seemed temporary in the doses in which it was possible to give it. The improvement must have been due therefore to the direct or indirect action of the braces. They did not increase the muscular spasm as has been claimed; on the contrary they relieved the patients, I feel sure, from a good deal of unconscious nervous strain, and thus they were enabled to get about, exercise, and enjoy out-of-door life more than otherwise would have been possible. The general tone of the nervous system was thus improved; and the mental impression that they were going to improve also exerted a powerful influence for good.

PHYSICAL TRAINING AND DEVELOPMENT AS A THERAPEUTIC MEASURE.

By B. E. McKENZIE, M.D.,
TORONTO.

The terms hereby employed—"physical training and development"—are to be understood as used in the widest sense as including massage, gymnastics, and athletics.

The essential difference between athletics and gymnastics is one of aim. The aim of athletics (unless of the illegitimate professional sort) is pleasurable activity for the sake of recreation; that of gymnastics is discipline or training for pleasure, health, and skill. Gymnastics are more highly developed, present more features of educational value, are more comprehensive in their aims, more systematic in their methods, and productive of more solid and considerable results. H. C. Wood defines massage as "a generic name for external manipulations which are employed for the purpose of affecting the nervous and muscular systems and the general circulation."

These terms are also to be understood as limited by well-recognized laws of physiology. The indiscriminate practice of athletics, the careless and unscientific use of gymnastics, and the employment of massage by those who are ignorant of anatomy and physiology are not to be indorsed.

The difficulties in the way of the proper use of these means of treatment are so great as to discourage nearly all medical men and to prevent them making any effort to employ them in practice.

The necessity for attention to the physical development of children will be apparent to anyone who will notice how many of them, especially in large centres of population, are unsymmetrical, distorted, and imperfectly developed. It is questionable whether the

so-called blessings of civilization represent an unmixed good; the intellectual and social attainments of our time are great, but they have not been effected without cost. In earlier times, when less humanitarian views prevailed and the customs of life did not permit a survival of the weakling, a process of natural selection made man more robust; and the great lungs, stout heart, mighty muscles, sturdy bearing, unqualing nerves of the forest dweller called for no special care to bring them to a high condition of physical efficiency. The rush of modern times, the competition in the schools, the prizes to be attained through intellectual and social advancement, however, seem to have made us forgetful of the fact that man is first an animal in order of development, and that physical vigor is the necessary substratum upon which must ever rest great attainments. The examination and careful measurements of primitive and uncivilized races and of the best models of Greek statuary prove that modern modes of dressing have greatly reduced the girth of the waist, displacing the stomach, liver, kidneys, and other abdominal and pelvic viscera, and interfering with their functional activity. The girth of the waist in woman should be but little less than that of the thorax, and normally it is larger proportionately to height in women than in men. Dr. Seaver, of Yale, reports measurements made of some of the best Greek statues, showing the girth of the waist among women to be only two or three per cent. smaller than the circumference of the thorax.

The following figures, taken from Kellogg and obtained in the measurement of women among the Chinese, Indian tribes, French, German, and Italian peasants, English and American women and men show, important facts regarding the relation of waist-girth to height:

	Av. height. Inches.	Av. waist. Inches.	Per cent.
American women	61.94	24.79	40.0
Telugu women of India	60.49	24.65	40.6
French women (peasants)	61.01	28.00	45.4
Chinese women	57.85	26.27	45.4
Yuma women	66.56	36.84	55.2
Civilized American men	67.96	29.46	43.3
Venus de Milo (statue)	.....	.....	47.6
Mrs. Langtry	67.00	26.00	38.8

At Wellesley College, Dr. Anna M. Wood has measured 1100 women between the ages of nineteen and twenty-one years, with the following result: Average height, 63 inches; average waist, 24.6 inches; percentage, 39.

Some measurements which I have made of women by whom I have been consulted because of some deformity of the trunk show the average percentage of waist to height to be below 37 per cent.

It is worthy of note that the measurements just given of American women were of those who ordinarily dressed in the conventional styles. The Telugu women wear their skirts supported by a cord drawn tightly about the waist. The French and German peasants for the most part support theirs from the shoulders and discard waist-bands. The Chinese are of low stature, being two inches below five feet, but have waists two inches greater in circumference than the ordinary American women or women of India. The women of the tribes of Arizona and New Mexico, unfettered by dress, have a waist measurement 55.2 per cent. of their height.

A large number of school-girls between the ages of eleven and thirteen years, upon examination gave a waist measure of 23.5 inches. A number of college-girls, about nineteen or twenty years of age, gave an average waist measure of 23.3 inches, thus showing that while general development had been going on, the waist-girth had been reduced two-tenths of an inch.

My purpose in referring to these measurements is to point out some of the evil results of modern customs and fashions—evils which are very far reaching, which require varying means for their remedy, but many of which are readily corrected by improved methods of dressing, throwing off the corset, bands, and all such restrictions from the thorax and waist, and following this by a proper attention to physical development. The erectness and symmetry of the trunk must depend largely upon its having an opportunity to develop fully in all its diameters. The injury resulting from restriction, though marked in the atrophy of the muscles, is not limited to these structures, but affects the osseous framework and cripples the contained viscera, whereby injury is done to the progeny, and a condition results which strongly predisposes to deformities of the trunk without the intervention of any distinctive pathological state.

Modern methods of dressing young women and girls cause the circumference of the waist and lower thorax to be reduced from one to five or six inches below the normal amount, though it is always claimed by women that no part of the clothing is tight; yet it is seldom that more than a half-inch of expansion is permitted in the lower thorax; and it may be safely stated that if the calf of one leg be restricted for a few months or weeks, in the same manner as the waist of the ordinary young woman, it would show marked atrophy compared with the other.

In woman the liver is proportionately larger than in man, and her girth at the waist is proportionately larger. Such constriction, therefore, is responsible for much of the displacement found in the abdominal and pelvic viscera and for atrophy of the trunk muscles, resulting finally in the distorted spine and other trunk deformities.

In 1887 the Massachusetts Medical Society appointed a commission to inquire into the work of gymnastics in the public schools. In the report made a year subsequently it was stated that in visiting the schools of New York the children of German parentage could be readily distinguished by their superior bearing and development, which resulted from their training in the German turnvereine.

Lawson Tait has spoken of the pessary mania. With just as much propriety might we speak of the craze for the use of braces and orthopedic appliances. In case of deformity in the far greater proportion of cases *per se* a brace should never be applied. We must here distinguish between deformity and disease. Braces, splints, and orthopedic appliances find their chief legitimate use in cases of disease where it becomes necessary to put the affected part at rest and to protect it from injury. Some cases of deformity there are where braces find a proper employment, but in the vast majority of instances either the surgeon's knife should be called into use or attention should be given to the rectification of the deformity by removing the restrictions of dress, by massage repeated at frequent intervals, and by regular and systematic drill by which the patient is taught to correct her own error.

I may best elucidate this part of my subject by briefly relating the following cases:

Case I.—M. P., a young woman, aged twenty-two years, five

feet eight inches in height, who for several months previously had been complaining of lameness, pain in the back and legs, had been treated for hip disease and for tubercular disease of the spine, and who, upon examination, showed a strongly marked lateral curvature, was much depressed and discouraged because of her condition. Was dressed in the conventional style, and had for years been in the habit of wearing tightly drawn corsets and bands. She was first taken before a large mirror and permitted to see and understand the amount and nature of her deformity. Then she was instructed how to stand and how to move her limbs and trunk so as to render the deformity less apparent. She was assisted in taking the best attitude that it was possible for her to assume. She was then put into a class with others who had deformities also, and given one hour a day in gymnastic work. Her work was so graded as to increase from day to day; thus for several months went on together the processes of teaching and development. On the one hand, careful attention was given so that she might understand the importance of always doing her best. The mirror was brought into constant use, so that she might fully appreciate her deformity and the power she had for self-correction. The encouragement afforded her by the manifest rapid improvement increased her confidence, and both in general health and in vigor her progress was most satisfactory. At the present time, after a lapse of two or three years, she presents an excellent figure and is in good health. The exact time when her deformity first appeared is not shown by her history, but it must have dated back several years previous to my first seeing her. It was noticeable that during the five months that she was directly under my care she found it necessary on several occasions to have her clothing so altered as to correspond with her increased measurements, thus showing that when the restricting clothing was removed and attention was given to the development of the abdominal and dorsal muscles that her girths greatly increased, allowing her to present normal measurements.

CASE II.—Boy, aged seven years. I found a poorly nourished boy with a moderately marked roto-lateral curvature. A few weeks later, when he came to me for treatment, he had chorea. Notwithstanding this the usual work in the gymnasium was begun. Improvement in the chorea was manifest in a few days, and in a week

the boy had assumed control of his muscles. He was able to obey accurately the commands of the instructor. In this connection it is worthy to remark that chorea, hysteria, and other nervous disorders have been reported as occurring less frequently in American schools where regular physical training has been introduced.

During the last seven years I have treated more than one hundred cases under circumstances which permit careful observation to be made. In my own house I have a gymnasium where, under the direction of a competent woman, systematic and careful exercise is given every day for a period varying from one-half hour to two hours. The cases dealt with have been chiefly those of roto-lateral curvature of the spine, pigeon-breast, flat-foot, and unsymmetrical development resulting from infantile paralysis. Incidentally, however, I have had opportunities for making observations in regard to other abnormal conditions, especially hysteria, weak lungs, and general debility.

In dealing with any case of spinal deformity the good results to be obtained depend not so much upon the particular exercises employed as upon the manner of using them. It is necessary, in the first place, to gain the confidence of the patient and a hearty co-operation. For this purpose I know of no other means so effective as the proper use of the mirror, to allow the patient to see her own deformity and to understand that its correction is not to be attained by the use of props or by influences from without, but by her own efforts. To this end class work is most important. If a patient be taken alone and given exercise it soon grows monotonous with most girls, and still more so is it useless to simply prescribe exercises to be taken at home. In themselves the exercises may be well selected and quite appropriate to the case, but the patient will gain nothing by the inefficient work which will be done in nine-tenths of all such cases. Nor is it possible for one who is not thoroughly furnished and ready in gymnastic resources to retain in her class the interest which is so essential to success.

As I am frequently present myself during the exercises, and as I examine personally all cases and repeat the examination at frequent intervals, making them in the presence of my assistant, the circumstances are peculiarly favorable for the most thorough and careful

study of each case and of the effects upon each individual of particular exercises.

It is a mistake commonly made that the purpose of exercise is chiefly or entirely to develop the muscles. True, muscle is increased in size and is purified by the removal from it of extraneous mattter, such as fat and connective tissue, and its aponeurotic attachments are strengthened; but so also is the power of co-ordination augmented, so that movements formerly thought to be complex are effected with ease, thus training the nervous system and saving it a great expenditure of force. As time goes on, what was found difficult becomes easy or is performed automatically. The one who has been well trained physically has better developed nerves as well as muscles, a quicker and more accurate co-ordination, a more elaborate organization of his spinal cord and of parts of his brain than has the individual whose muscular system is imperfectly developed.

In the accomplishing of an act muscular power is not more concerned than nerve condition. In fatigue, nerve-exhaustion is largely concerned. Conversely, in the training which leads to a correct bearing and form, the nerve-centres which govern muscular actions are themselves exercised and strengthened. Thus a physiological basis is afforded for an explanation of the fact that cases of infantile paralysis are improved by physical training. The condition commonly existing, in these cases is, that not all the ganglionic cells in the spinal centres affected are destroyed, but that some of them maintain connection with their muscles. By physical training these may be developed and their functions greatly increased.

Incidentally a patient is taught to breathe much more deeply and to exhale much more completely, thus strengthening and training the respiratory apparatus so that a girl who, perhaps, had never inhaled a full breath since the days of crying infancy, takes into her lungs regularly twice as much pure air as was her wont. By this exercise being repeated I have seen a hollow and unsymmetrical chest assume a well-rounded and symmetrical form, and at the same time improved color and fulness of the cheeks, limbs, and trunk, and an increased tone in the muscle, and alertness of bearing that betokened a much higher plane of vitality.

In dealing with defects in the limbs or feet arising from paralysis or other forms of weakness—in such cases as may best be treated

by exercise—the personal equation is of less moment. Repeated exercise and massage will accomplish its results without so definite a dependence upon the co-operation of the patient.

In postural deformities, however, the personal equation is of great importance, and the best and most complete success is attainable only when the hearty and intelligent co-operation of the patient is secured.

All the methods and advantages of massage are well understood and appreciated by the profession. By such means, however, it is difficult to produce much effect upon the deeply placed structures of the spinal column. No ordinary methods will succeed in influencing the circulation in the bodies of the vertebræ or in their disks or ligaments. When the patient, however, is suspended by straps passing under the chin and occiput, and the entire weight of the body is thus allowed to stretch the shortened structures of the spine on the side of the concavity, the alternate stretching and relaxation, together with the moulding of the bony thorax by the hands of the operator, increase the circulation in these parts, and the nutrition of the spine is increased. In the first efforts it is necessary to proceed with great caution that injury may not be done, but when this is repeated daily it causes no discomfort and is a means of giving massage to the most deeply lying parts of the dorsum of the skeleton.

Though my own efforts and observations have been confined chiefly to the correction of deformities and in strengthening weak parts, yet I have seen the results of systematic physical exercise as shown in the digestive apparatus which was stimulated and strengthened, appetite being improved, absorption made more rapid, circulation through the liver more vigorous and even, the bowels more active and regular, through the general improvement and the greater strength and tonicity of the abdominal muscles. Its effects have been long recognized in the treatment of those who are mentally imperfect. Both imbeciles and criminals, as a class, have physical proportions that are far below the normal; and the work done by Dr. Seguin, and more recently by Dr. Hamilton D. Wey in the Elmira Reformitory, point to a valuable but much neglected means by which the condition of these unfortunates could be much improved.

For the use of systematic exercises as a therapeutic agent I would claim :

1. That it has not been sufficiently employed by the medical profession.

2. That modern modes of living are rendering attention to this subject more imperative.

3. That while it is the most efficient agent which can be employed in the treatment of deformities, and while it is an aid to all others, yet that it does not take the place of tried and proved methods.

4. That it demands for its most successful use that we shall have persons who are trained especially for the performance of the work.

5. That its purpose is not only and chiefly to develop muscles, but to reach the whole being, improving and strengthening the nervous, digestive, and circulatory apparatus.

OBSERVATIONS ON CONGENITAL DISPLACEMENT (THE SO-CALLED CONGENITAL DISLOCATION) AT THE HIP-JOINT; AND THE SUCCESS OF DR. BUCKMINSTER BROWN'S TREATMENT BY RECUMBENCY WITH EXTENSION FOR TWO YEARS.

By WILLIAM ADAMS, F.R.C.S.,
LONDON, ENGLAND.

The subject upon which I propose to offer a few observations to the members of the American Orthopedic Association is one of special interest to American surgeons, as the treatment is essentially of American origin, and was inaugurated by Dr. Buckminster Brown, of Boston, in the year 1885, when he published his valuable monograph on *Double Congenital Displacement of the Hip*, and recorded a case of double congenital displacement occurring in a child aged four years, in which the treatment by extension with recumbency for two years and three months was eminently successful and well represented in the photographs. In a letter which I received from Dr. Brown he states that the advantage gained had been fairly well maintained, though not quite to the full extent.

It is only by strictly following out the directions given out by Dr. Brown that I have been able successfully to treat a number of these cases.

I am, therefore, anxious to avail myself of the present opportunity of recording in America, with a deep sense of gratitude, the results of Dr. Brown's treatment and any additional information I may have obtained since the subject was first brought to my notice.

It was my good fortune to have this affection first pointed out to me by Dr. Carnochan himself in the year 1844, when he was in

England and demonstrated a case to the surgical staff at St. Thomas's Hospital, when I was curator of the Museum and Demonstrator of Morbid Anatomy. This was the first case diagnosed and described in England. Three lithograph plates of this case—Benjamin G., aged eighteen years—are given in Dr. Carnochan's book.

My attention has ever since been directed to this affection when diagnosing obscure cases of lameness in children, and there are no symptoms to direct the attention to the malformation of the hip-joint until the walking period has commenced, but from that time they steadily increase. I have read three papers on this subject at the meetings of the British Medical Association, in 1885, 1886, and 1889, and have also brought it before the Pathological Society on two occasions, viz., April 19, 1887, and January 29, 1889, with the view of contributing to our knowledge of this affection, which has hitherto attracted such a small share of attention.

In the first paper, in 1885,[1] my tabulated series of sixty cases, forty-eight of which occurred in my private practice, and have therefore a reliable history, completely destroyed the theory of this being an accoucheur's dislocation from violence employed during delivery in breech presentations, which these cases have been assumed to be. Several of the children were born before the accoucheur arrived; and in many instances the labor was described as being easy and natural. It also has important bearings on other statements incorrectly made in surgical text-books. It was a clinical contribution, supplementary to the exhibition by Prof. Bennett, of Dublin, of a recent specimen which was of great interest to me, as I had never seen a recent dissection, and but for this accidental circumstance my table would never have been published.

My second paper, in 1886,[2] was written after I had changed my views with regard to the hopefulness of treatment, consequent upon the publication of a case very successfully treated by the well-known American surgeon, Dr. Buckminster Brown, of Boston, in 1885. The success in this case encouraged me to persevere with recumbency and extension, but I wished to avoid confinement to the bed and

[1] Read at the meeting of the British Medical Association held at Cardiff, July 29, 1885, and published in the British Medical Journal, November 7, 1885.

[2] Read at the meeting of the British Medical Association held at Brighton on August 12, 1886, and published in the British Medical Journal, April 23, 1887.

the elaborate contrivances for extension. I therefore carried out the extension by means of an improved extension-couch, with a movable plane on which the child could be carried out daily in the open air, on a spinal carriage, the extension acting all the time. I drew the design for this couch, and Mr. Ernst constructed it upon the best possible principle.

In my third paper, in 1889,[1] I published the results of Dr. B. Brown's treatment in two cases which had completed the full term of two years' recumbency with extension, and had been walking about for some months, wearing a steel support resembling the American hip-joint instrument of Prof. Sayre. Up to that date nothing could be more satisfactory, so that I hope a substantial advance in treatment has been made without injury to the general health.

To assist in the study of the pathological conditions exhibited in these cases, it appeareed to me to be desirable to collect all the specimens from the London Museums, either known or believed to be examples of congenital displacement; and at the meeting of the Pathological Society on April 19, 1887,[2] all the reliable specimens, six in number, in the London Museums, were exhibited, at my suggestion, through the kindness of the gentlemen connected with the different hospitals.

All the specimens exhibited agreed as to the essential deviations in the pelvic bones met with in these cases, viz., the absence of the acetabulum, which is represented only by a flattened, triangular depression, the base of which corresponds to the margin of the obturator foramen; the narrowing and elongation of the innominate bones in the natural situation of the acetabulum; eversion of the tuberosities; alteration in the pelvic diameters; altered direction of the alæ; the presence of a deep groove below the anterior superior spinous process of the ilium, around which the conjoined tendons of the psoas and iliacus muscles play in their altered direction upward and outward toward the small trochanters.

[1] Read at the meeting of the British Medical Association held at Leeds on August 16, 1889, and published in the British Medical Journal, February 22, 1890.

[2] See report of this meeting, with description of the specimens exhibited, in the British Medical Journal, April 23, 1887. Illustrations of all these specimens are given in Plates Nos. 11, 12, 13, 14, 15, 16, and 16a, vol. xxxviii., 1887, of the Transactions of the Pathological Society of London.

The specimens also agreed in exhibiting similar changes in the head of the femur, viz., diminution in size and alteration in shape, such as an irregular flattening; but these changes varied very much in extent in different specimens. The axis of the neck of the femur was in some cases altered in direction as described by Hutton, of Dublin, but this varied very much in degree.

The wet preparations from St. Thomas's and St. Bartholomew's Hospitals also exhibited the dilatation and elongation of the capsular ligament, which becomes greatly thickened and still invests the head of the femur, which has never been found to be external to the capsular ligament. (*Transactions Pathological Society*, London, 1887, vol. xxxviii. Plates 12 and 13.)

At the meeting of the Pathological Society on January 29, 1889,[1] I had also the gratifying opportunity of exhibiting an American specimen of historical interest, as being the one from the dissection of which in the year 1850 the late Dr. Carnochan drew his description of the pathological conditions met with in this affection. These are represented in Plates 6 and 7 in his work published in 1850. Dr. Carnochan died suddenly on October 28, 1887, at the age of seventy years, and had left a request that this specimen and the original drawings, taken during the progress of the dissection, should be sent to me, and they arrived on October 13, 1888. The specimen and drawings are now deposited in the Museum of the Royal College of Surgeons.[2]

Dr. Carnochan read his last paper on this subject at the International Medical Congress held at Washington in September, 1887, about six months previous to his death, and referred to his own early work, and to the recent observations published by myself and others in the *Pathological Society Transactions of London.*

The pathology of this affection is undoubtedly of French origin, and belongs to the celebrated surgeon and physiologist, Baron Dupuytren, from whose invaluable museum Dr. Carnochan gathered much of his knowledge. Baron Dupuytren gave his opinion in favor of malformation, without describing minutely the changes

[1] In the British Medical Journal of February, 1889, there is a report of the proceedings of this meeting, and also the description I gave of Dr. Carnochan's specimen.

[2] The original specimen, which has been allowed to become dry, is also represented in its anterior and posterior aspects in vol. xl., Plates 20 and 21, of the Transactions of the Pathological Society of London, 1889.

in the acetabulum, etc., which I have been enabled to do. Baron Dupuytren also made some important clinical observations.

The clinical history is also of French origin, and largely due to the late Prof. Jules Guérin, the pioneer of subcutaneous surgery, whose clinique Dr. Carnochan sedulously attended.

The introduction into England of our knowledge of congenital displacement of the hip is undoubtedly due to Dr. Carnochan when he exhibited an example of congenital displacement of both hips in a boy aged eighteen years--Benjamin G.—and demonstrated the condition described by Dupuytren and Guérin to the staff of St. Thomas's Hospital in the year 1844, when I happened to be Curator of the Museum and Demonstrator of Morbid Anatomy. A plaster mould of this case, made at the suggestion of the late John Flint South, is still preserved in the Museum of the Hospital, though in a mutilated form.

I now propose to describe four unpublished cases of congenital displacement of the hip, in which Dr. Buckminster Brown's treatment by prolonged recumbency with extension has been carried out for a period of two years or more.

My list of such cases, of which I have careful records, includes six cases, extending from 1886 to 1890. The subsequent cases are not yet complete.

The first two cases on my list, Miss S., in 1886, and Miss W., in 1886, have already been published. The paper in which these cases were described and the principles of treatment explained, with wood engravings of the extension couch in use, was read at the meeting of the British Medical Association, held at Leeds, on August 16, 1889. This paper was subsequently published in the *British Medical Journal*, February 22, 1890, with wood engravings of the extension couch.

Case III. *Congenital displacement of right hip-joint, treated by recumbency with extension for three years.*—Miss S., aged eleven years on June 26, 1889, was sent to me by Dr. Miller, of Blackheath, on March 15, 1889. The objective symptoms of congenital displacement of the right hip-joint were now far advanced, with tilting of the pelvis and severe spinal curvature in the lower dorsal and lumbar regions. She walked with an extreme degree of lameness and obvious deformity.

I had seen this young lady when three years of age, with Dr. Miller, long before the success of Dr. Buckminster Brown's treatment was published in 1885. I appointed a consultation with Dr. Miller, that we might make a careful examination and decide whether Dr. B. Brown's treatment was applicable in a case of such severity at the age of eleven years.

On March 21, 1889, I made a careful examination of the case with Dr. Miller. On the right side it was clear that the head of the femur was resting on the dorsum ilio. The top of the great trochanter rose above the horizontal line drawn from the anterior superior spinous process, so that the ilio-femoral triangle was obliterated.

On the left side the base of the ilio-femoral triangle measured two inches and a quarter. On the right side there was a certain amount of sliding up-and-down movements, to the extent of an inch or more, when a moderate amount of extension was used.

The tilting of the pelvis was considerable, and the spinal curvature in the lumbar region with the convexity to the right side was also very considerable.

Dr. Miller and myself agreed that in order to prevent the threatened evils of increasing deformity the treatment by prolonged recumbency with extension should be carried out; and to this the parents readily assented.

On May 6, 1889, the extension couch was applied by Mr. Ernst, and both Dr. Miller and the mother of our patient devoted their best attention to all the details connected with the management of the extension apparatus.

On June 17, 1889, I paid a visit to this patient and met Dr. Miller. The extension treatment had been borne without any inconvenience, and now we found that with a moderate amount of extension in the recumbent position the base of the ilio-femoral triangle on the right side measured one inch and a half, that on the left side being two inches and a quarter.

It was not necessary for me to see this young lady again until June 19, 1890, when I paid a visit, and met Dr. Miller. He then found that with a very moderate amount of extension in the recumbent position the base of the right ilio-femoral triangle measured

two inches, the left, of course, remaining as before, at two inches and a quarter.

Dr. Miller now observed that the right leg, *i. e.*, on the affected side, appeared to be one inch longer than the left, in the recumbent position. This was evidently due to the severe tilting of the pelvis. We found that the left anterior superior spinous process was nearly two inches above the level of the right. The spinal curvature to the right in the lumbar region was still very severe. Dr. Miller and myself agreed to recommend that weight extension should be applied to both legs, in the hope of correcting the pelvic tilting.

I did not see this young lady again until May 19, 1891, when I again met Dr. Miller. We found now that without extension in the recumbent position the base of the right ilio-femoral triangle measured one inch and a quarter, and there seemed to be no disposition in the head of the femur to ascend, the base of the left triangle remaining the same, viz., two inches and a quarter; the actual shortening was only one inch. This young lady has now completed her two years of recumbency, but we advised that this should be prolonged.

On November 26, 1891, we met again, but found no further change had taken place.

On June 7, 1892, I paid another visit to this young lady, and met Dr. Miller. The base of the right ilio-femoral triangle now measured one inch and a quarter in the recumbent position without any extension. The left, as usual, two inches and a quarter. The pelvic tilting has greatly diminished, and the spinal curvature is very much less. The general health is extremely good and has never been interfered with, but as the case seems to have been at a standstill for some time, and she has completed her three years of recumbency with extension, and is just fourteen years of age, we agreed that a little walking might be very carefully commenced, with a hip-joint extension instrument on the right leg and a raised boot on the left, using crutches and also a felt-jacket to assist in maintaining the general balance of the body and support the spine.

On July 16, 1892, the walking apparatus was applied by Mr. Ernst with Dr. Miller's assistance.

On November 23, 1892, I again visited the patient, and met Dr. Miller. She was now walking about the room, with the hip-joint

instrument and wearing the felt-jacket, and using crutches. Dr. Miller had made a careful measurement and found that the base of the right ilio-femoral triangle fully maintained the improvement.

On June 20, 1893, I went again to see Miss S., and met Dr. Miller. Miss S. has now been walking with the hip-joint instrument and crutches for one year, and we therefore made a careful examination with measurements of the ilio-femoral triangle, and I was glad to find that no ground had been lost.

The base of the right ilio-femoral triangle still measured one inch and a quarter, and the base of the left two inches.

There is no disposition to displacement upward of the head of the right femur when a moderate amount of force is used.

The pelvic tilting is very much diminished, but still when lying down the right leg appears to be about one inch longer than the left.

The muscular development is improving with exercise and massage, and the general health is excellent.

This seems to have been the last careful examination with measurements made in this case.

The subsequent progress was only a very gradual discontinuance of the steel hip-joint apparatus with crutches, and the use of ordinary boots without steel supports, the right boot being raised one inch. The result was extremely satisfactory, considering the age at which the case was undertaken.

CASE IV. *Congenital displacement of left hip treated by recumbency with extension for rather more than two years.*—Miss V. G., aged four years, in May, 1890, was brought to me by Dr. A. H. Buck, of Primrose Hill Road, on May 5, 1890, and presented all the usual objective symptoms of congenital displacement of the left hip-joint. This young lady had been brought to me two years ago, when I correctly diagnosed the case and advised Dr. Buckminster Brown's treatment by recumbency with extension ; but the parents were not willing to submit to this. Increasing lameness, with the dread of increasing deformity, however, made them anxious, with the advice of Dr. Buck, to submit to treatment.

Dr. Buck and myself made to-day a careful examination and found that the base of the left ilio-femoral triangle was obliterated by the top of the great trochanter rising a little above the horizontal

line drawn from the anterior superior spinous process. The base of the right ilio-femoral triangle measured one inch and a quarter. The shortening of the left leg, as measured at the knee and ankle-joints, was one inch and a quarter.

The head of the left femur moves up and down with a little extension through nearly one inch.

The head of the femur is displaced upward and a little backward on to the dorsum ilii. The lameness in walking is very great, and she turns the left foot a little outward, but not so much as in many cases.

The left leg is altogether rather smaller than the right, and the muscles comparatively flabby, the glutei included. The left thigh is one inch smaller than the right; and the left calf is half an inch smaller than the right.

History. This was the second child and the labor easy, and presentation natural.

On July 19, 1890, the extension treatment was commenced, and as soon as the mother, a very intelligent lady and devoted to her daughter, had mastered the details of the extension couch, with Dr. Buck's assistance and the help of a trained nurse, this young lady was taken to the seaside.

On November 3, 1890, I visited this patient again, and met Dr. Buck, and now we found that the base of the left ilio-femoral triangle measured one inch, with moderate extension in the recumbent position. The base of the right triangle measured one inch and a quarter.

On February 27, 1891, I again saw this patient with Dr. Buck, and the progress was in every way satisfactory. The base of the left ilio-femoral triangle now measured one inch and a quarter, when a moderate amount of extension was made in the recumbent position; and the base of the right triangle was also one inch and a quarter.

On July 17, 1891, I met Dr. Buck again in consultation in this case, and we found that the improvement had been well maintained. The base of the left ilio-femoral triangle measured one inch and a quarter with a moderate amount of extension in the recumbent position; and the base of the right was also one inch and a quarter.

On February 5, 1892, Dr. Buck again made careful examinations

with me, and we found that the base of the left ilio-femoral triangle measured one inch and a quarter, or, we thought, three-eighths, whilst the base of the right ilio-femoral triangle measured one inch and a half (a slight increase from growth). This young lady has had a mild attack of influenza, but otherwise the general health has been extremely good.

On June 29, 1892, I again met Dr. Buck in consultation, and we found that all the improvement had been well sustained after the two years of treatment. The left ilio-femoral triangle still measured an inch and a half without any extension being applied; and the base of the right ilio-femoral triangle measured one inch and a half—a slight gain from growth during the two years of treatment.

The general health is perfect and has never been interfered with.

Dr. Buck and myself agreed that our patient might now begin to walk with a steel support resembling Prof. Sayre's hip-joint instrument, and using crutches.

On July 25, 1892, the walking apparatus was applied, and to this she soon became accustomed, but only for a quarter of an hour for two or three times a day.

In August, 1892, Miss. G. gradually increased her walking until we met again.

On November 2, 1892, Dr. Buck and myself again examined our patient, and found that the base of the left ilio-femoral triangle measured one inch and three-eighths; that of the right measured one inch and six-eighths.

We also found that there was no movement of the head of the left femur upward, independently of the pelvis, so that all the muscular and fibrous structures had become accommodated to the improved position of the head of the femur. The glutei muscles on the left side are feeble, and we advised more massage in this region.

On April 25, 1893, I again visited this patient and met Dr. Buck. We found that the base of the left ilio-femoral triangle was still one inch and a quarter, whilst that of the right was one inch and three-quarters.

She has now been ten months with the hip-joint instrument and crutches. We agreed that this might be gradually diminished.

On February 14, 1894, I went to see this young lady again, un-

fortunately without meeting my friend, Dr. Buck, who died a short time since from an acute febrile attack.

Miss G. has now been walking with the hip-joint instrument and crutches for a year, but the raised boot and iron patten have been discontinued. She still sleeps on the extension-couch with slight extension. The base of the left ilio-femoral triangle measures one inch and a quarter, and that of the right one inch and a half. The shortening of the left leg, as measured at the malleoli, is rather less than half an inch.

On June 29, 1894, I went again to see Miss G., who is steadily improving, and I directed that she might leave off the instrument half the day, and the crutches gradually. The measurements the same as before. There is no spinal curvature whatever, and no tilting of the pelvis. The shortening of the leg seems only to be a quarter of an inch.

On July 23, 1895, this young lady was brought to see me, and it is now five years since the treatment commenced. Nothing could be more satisfactory than the result gained. She is wearing an ordinary boot, raised only a quarter of an inch inside. She walks with only a slight limp, and this seems to be chiefly due to some loss of the flexibility at the ankle-joint caused by a slight contraction of the Achilles tendon. I have seen this in one or two other instances, but it always yields to massage with passive movements of flexion and extension.

There is no spinal curvature, nor is there any tilting of the pelvis. The base of the left ilio-femoral triangle measures one inch and an eighth, and that of the right one inch and a half.

Case V. *Congenital displacement of the left hip-joint treated by recumbency with extension for nearly three years.*—Miss D. H., aged six years, in February, 1890, was brought to me on May 6, 1890.

All the objective symptoms of the congenital displacement of the left hip-joint. The ilio-femoral triangle on the left side was obliterated, as the top of the great trochanter rose a little above the level of the horizontal line drawn from the anterior superior spinous process.

The base of the ilio-femoral triangle on the right side measured one inch and a quarter.

The shortening of the left leg is about one inch and a half, and she wears a boot raised one inch and a half. The lameness in walking is very considerable.

History. This was a first child, but the labor was easy, with a natural head-presentation.

The head of the left thigh bone was found to move upward and downward to the extent of one inch or more.

I advised treatment by recumbency with extension.

On June 26, 1890, the extension-couch was applied and the treatment commenced, the case being carefully watched and attended to by Dr. Charles Edmund Aikin; a good nurse was also secured, and an aunt devoted constant attention to the case. It has been my good fortune, with one exception, to attend these cases in conjunction with medical men who have taken up the treatment with enthusiasm, and to this circumstance much of the good results may be attributed.

On August 6, 1890, I saw this patient with Dr. Aikin. The treatment has been well borne, and the base of the left ilio-femoral triangle now measured half an inch; that of the right being one inch and a quarter.

On November 28, 1890, I met Dr. Aikin again in this case, and was glad to find some improvement going on. The base of the left ilio-femoral triangle measured three-quarters of an inch; the right being one inch and a quarter.

On May 12, 1891, I saw this patient again with Dr. Aikin. The base of the left ilio-femoral triangle measured one inch; the right being one inch and a quarter. The spinal curvature was much diminished.

On December 8, 1891, I met Dr. Aikin again and we found some improvement. The base of the left ilio-femoral triangle measured very nearly one inch; the right being one inch and a quarter.

On March 28, 1892, Dr. Aikin and myself examined this patient again, and found the measurement remained the same as before. The subsequent progress of this case was satisfactory, and on November 30, 1892, she began to walk with steel supports and crutches, and gradually improved, walking only with a slight limp.

CASE VI. *Congenital displacement of the left hip-joint treated*

by extension, with recumbency, for three years.—Miss R., aged seven years, the sixth case on my list, was brought to me on June 4, 1890, and the case was evidently one of congenital displacement of the head of the femur on the left side (the so-called congenital dislocation). All the usual objective symptoms were present, such as the limping gait, with the foot everted, etc.

In the standing position, the ilio-femoral triangle on the left side was obliterated by the great trochanter rising above the horizontal line. The base of the ilio-femoral triangle on the right side measured one inch and a half.

In the lying-down position, the base of the left ilio-femoral triangle measured half an inch, with a limited range of motion in the up and down direction; abduction and rotation movements were limited.

History. This was the fifth child; it was a quick labor, and the medical man did not arrive till after the child was born; the presentation was said to be natural.

Treatment. I advised prolonged recumbency with extension on my improved couch.

The extension-couch was supplied by Mr. Ernst on July 5, 1890, and the treatment commenced, gradually for a few weeks. This young lady soon became accustomed to the recumbency and extension treatment, which was most carefully carried out by the wife of the clergyman in whose house she had been placed to live at the seaside, fifty miles from London. Visits at long intervals were therefore only necessary. At about the ninth month it was noticed that the mobility at the hip was greatly diminished, but I have no memorandum of the visit.

On July 22, 1891, Miss R. was brought to London, and the progress made was in every respect satisfactory. The head of the femur had descended toward its natural position, and the difference in the measurement at the base of the ilio-femoral triangle was diminished. Her general health has been thoroughly well maintained. She was brought to London on the extension-couch in the train, and in an omnibus-carriage from the station to my house.

On April 8, 1892, Miss R. was again brought to London. The improvement has increased. The base of the left ilio-femoral triangle now measures one inch and a quarter, and on the right side

the base measures two inches. When lying down the ankles are on the same level, so that no shortening is apparent, but in consequence of the pelvic tilting caused by the spinal curvature in the lumbar and lower dorsal region, with the convexity to the left, the right anterior superior spinous process is raised three-quarters of an inch higher than the corresponding process on the left side. The general health is excellent.

On July 22, 1892, I made another careful examination, and the base of the left ilio-femoral triangle now measured one inch and three-quarters, the right being two and a quarter. The pelvic tilting and the spinal curvature are both very much diminished.

On October 28, 1892, I found some further improvement; the base of the left ilio-femoral triangle measured one inch and seven-eighths, and the right two inches and a quarter. The tilting of the pelvis and spinal curvature have both diminished, but are not removed.

As Miss R. has now been two years and three months under the recumbency and extension treatment, I thought that a change in the treatment might be commenced, as it was doubtful how long this young lady would be allowed to remain in England, and the fixation of the head of the femur in its improved position seemed to be fairly complete. I found that when direct pressure was made from the foot upward, the knees being held straight, there was no disposition to displacement upward, *i. e.*, no motion upward independently of the pelvis. I therefore ordered the usual steel support for walking to be prepared. If, however, it should be decided that this young lady could remain a year or more in England, I recommended prolongation of the recumbency and extension treatment on account of the spinal curvature and tilting of the pelvis.

On December 16, 1892, Mr. Ernst applied the walking apparatus, and on a light, experimental trip she made a good start. I only allowed her to walk for ten minutes two or three times a day.

On April 3, 1893, Miss R. was brought to London, and I found that the improvement gained had been fully maintained. A little walking exercise with the steel support seemed to be a relief, and the massage over the gluteal region and the muscles of the thigh and inner side of the left knee improved the muscular development.

On July 14, 1893, the report was the same.

On October 20, 1893, there appeared to be a still further gain in muscular development, while the hip-joint measurements were equally good.

On April 24, 1894, Miss R. was brought to see me, and I was glad to find the improved condition had been fully maintained.

No precise measurements of the base of the ilio-femoral triangle were made, as I was in ill health at the time, having suffered from three attacks of influenza in 1891, 1892, and 1893, and a severe domestic affliction in January, 1894.

On July 10, 1894, Miss R. was brought to see me, and I made a careful examination with measurements of the base of the ilio-femoral triangle. The shortening of the left leg was now only a quarter of an inch. The base of the left ilio-triangle measured one inch and three-quarters ; that of the right being two inches.

On October 4, 1894, Miss R. was brought to me. I found all the measurements the same as in July. The spinal curvature had so much diminished that when lying down it can hardly be detected. The tilting of the pelvis is now very slight. She walks one hour and a half a day ; half an hour each time, still using the hip-joint extension instrument, and walks with two sticks ; she uses her crutches very little. She also sits in a chair for an hour and a half every day. She still sleeps on the extension-couch. She has always used the bed-pan up to the present time, but this is now to be discontinued.

On October 16, 1894, Miss R. came again to see me. I allowed her to walk to-day without any steel support, but using two sticks ; left boot raised a quarter of an inch. The base of the left ilio-femoral triangle measured one inch and a half and the right two inches. The hip-joint seems to be strong and very perfect. I allowed her to walk for a quarter of an hour without steels, but much more freely with steels.

On October 24, 1894, I again saw Miss R. Hip-joint seems to be very perfect and stands work well.

On November 8, 1894, hip-joint very strong. I ordered walking without steels to be increased to half an hour twice a day

January 16, 1895. Miss R. paid visit to-day. The improvement gained in the position of the left hip-joint has been well maintained. The muscular development has been increased by the exer-

cise allowed in walking, and also by shampooing and special movements judiciously applied.

The spinal curvature seems almost to have disappeared. The general health is excellent.

April 5, 1895. All the conditions are as good as in the last report, and there does not seem to be more than a quarter of an inch of shortening. The ilio-femoral triangles measure as before.

To-day I noticed for the first time a slight inclination to knock-knee on the left (the affected) side. Miss R. is a very tall girl, and comes of a tall Irish family, and as this knee is evidently not fit to bear the strain of the full weight of the body in walking, I ordered the steel support to be used for part of the day, especially when walking with only two sticks; and I also ordered additional shampooing to the inner side of the knee-joint.

June 5, 1895. Miss R., aged twelve years on March 10th last, was to-day very carefully examined by Mr. Stephen Paget and myself, and this being the last visit before leaving England, Sir James Paget and Mr. T. Bryant were invited to the consultation, but were unable to attend. Mr. Bryant, whose name is so intimately associated with the ilio-femoral triangle as an aid to the diagnosis of fracture of the neck of the thigh bone, would have been much pleased with the result of the treatment in this case. Miss R. has now passed through a treatment of nearly five years' duration—three years of complete recumbency with extension—prolonged in consequence of severe spinal curvature with rotation in the lumbar region, and after this the subsequent changes were made very slowly.

The report on June 5, 1895, runs as follows:

In the recumbent position we found the base of the left ilio-femoral triangle, *i. e.*, on the affected side, to measure rather more than one inch and a quarter; and the base of the right ilio-femoral triangle, *i. e.*, on the healthy side, measured two inches. The difference was, therefore, about half an inch.

In the erect position, without any mechanical support, and bearing the weight rather lightly on the left leg, this measurement was fully maintained. The head of the femur had no disposition to ascend. The test seemed to be sufficient, and we did not allow her

to walk without the steel support, in consequence of the weakness of the left knee-joint.

The fixation of the head of the femur, very nearly in its natural position, seemed to be perfect, and all the movements at the hip-joint are also very perfect, so that the muscular and other structures have adapted themselves to the improved position.

Miss R. has good voluntary power of flexion and extension from the hip-joint; and the movements of abduction, adduction, and rotation are also very good. Mr. Paget tested all these.

The glutei and other hip-joint muscles have much improved by massage and the exercise of walking, which she is now allowed to take freely with the steel support and two sticks, or using a pair of crutches when she walks without the steel support. This seems to be prudent in consequence of the weakness of the left knee-joint and inclination to knock-knee. She is a very tall girl for her age, and knock-knee might easily increase without support, as well as massage. She still continues to wear the felt-jacket, to check any disposition to lean to the left side.

The spinal curvature in the lower dorsal and lumbar regions had been, to all external appearances, completely cured by the long-continued recumbency. No evidence of rotation existed, *i. e.*, no prominence of the lumbar muscles on one side and depression of the other, and the spinous processes were quite straight.

No tilting of the pelvis existed; the anterior superior spinous processes on either side were quite on a horizontal line.

The general health has never suffered by the prolonged recumbency, and she now looks the picture of health and strength. Through the whole treatment she was placed to live in the house of a clergyman by the seaside, whose wife devoted unbounded attention to all the details of treatment, and every day, weather permitting, she was drawn out in a spinal-carriage, the extension being continued.

This was the last visit paid by Miss R. before leaving England for her home in Ireland.

Nothing could be more satisfactory than the results of Dr. Buckminster Brown's treatment in this case.

Fig. 1.

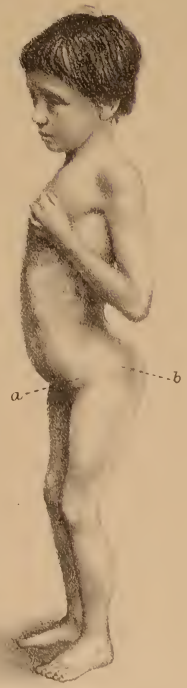


Fig. 2.

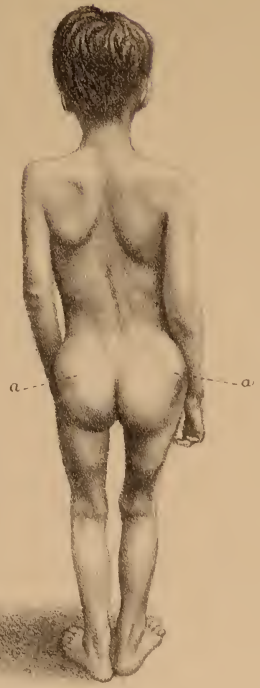


Fig. 3.

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Fig. 1.

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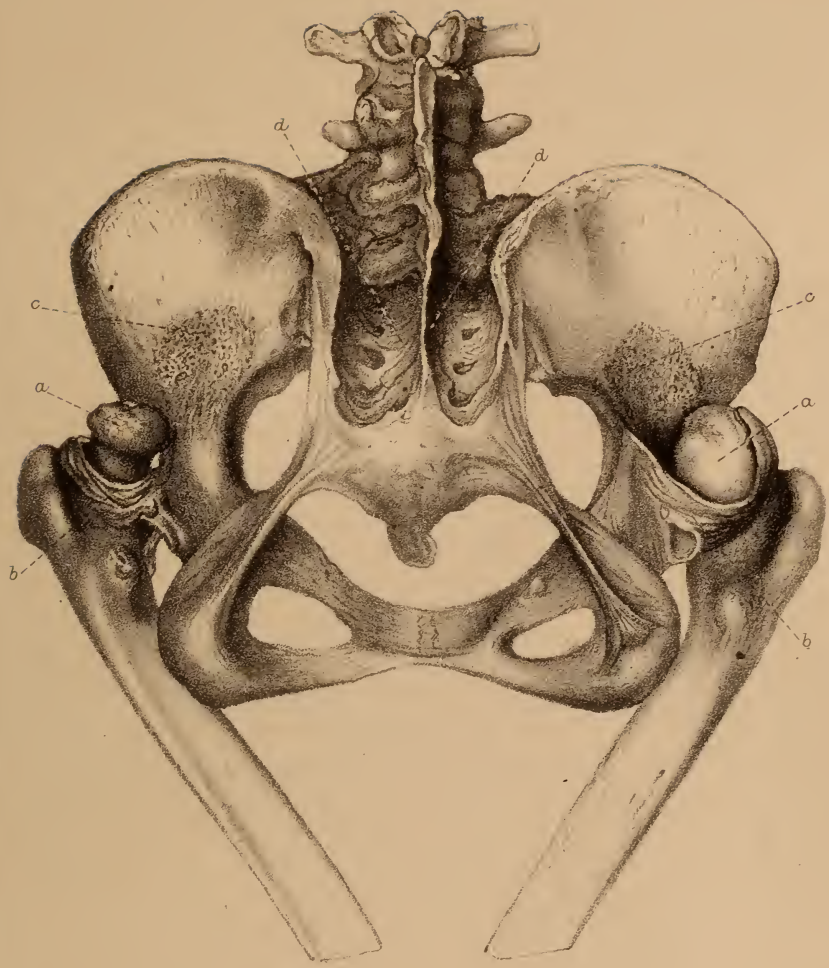
Horace Knight lith. from Photo.

West, Newman & Co. imp.



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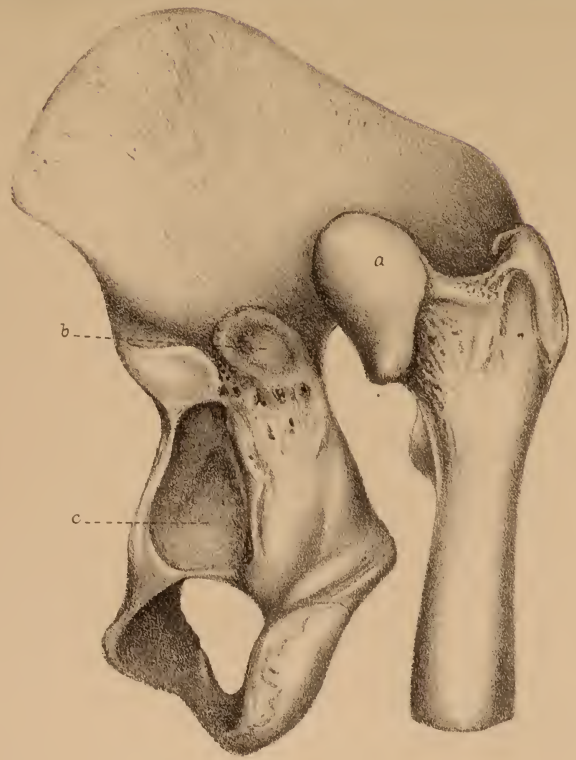

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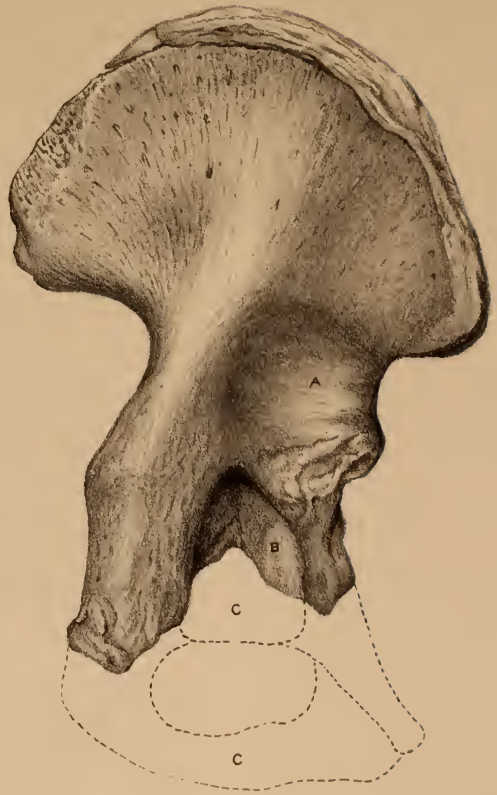

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Plate X.

Fig 1

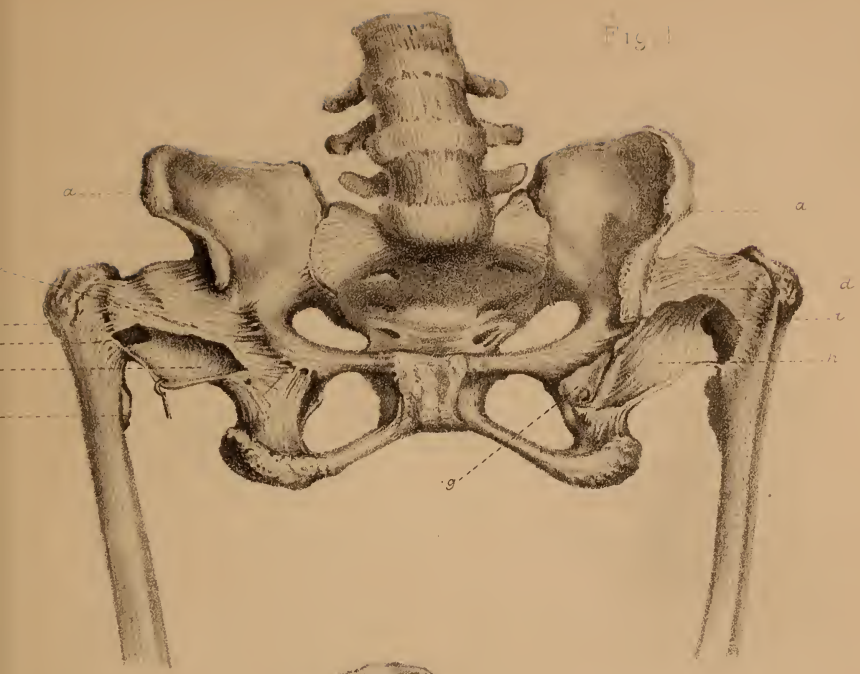
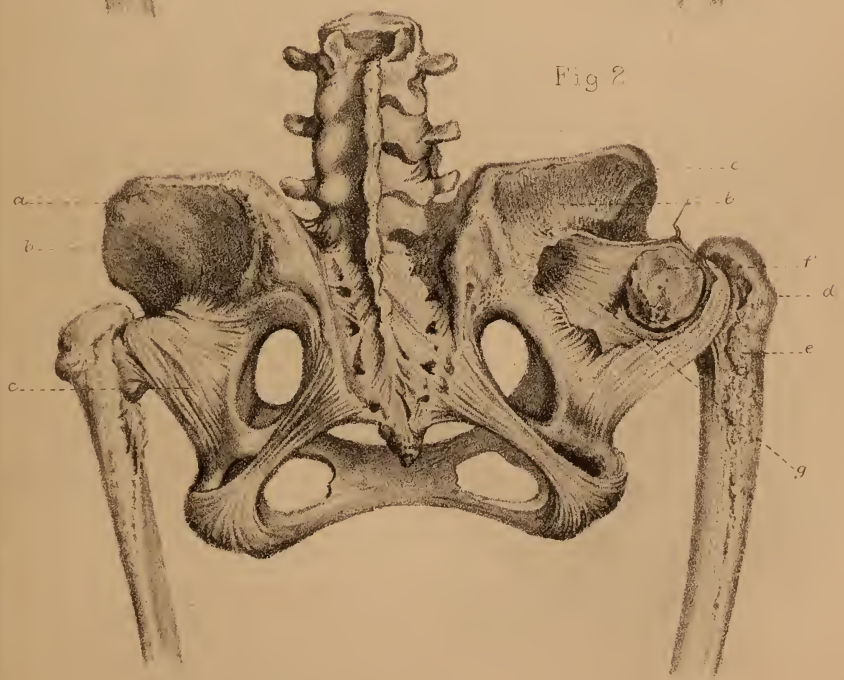


Fig 2



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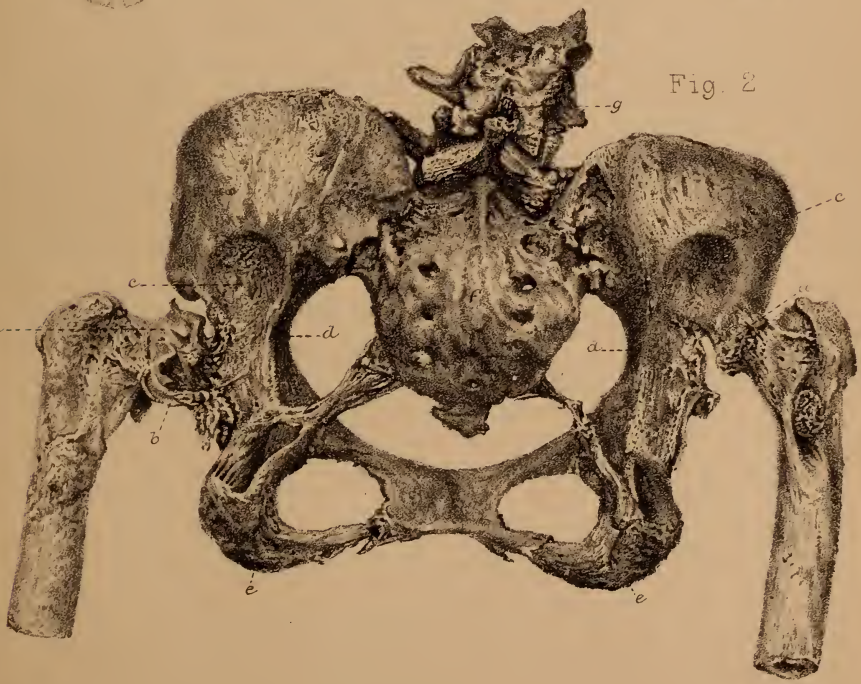

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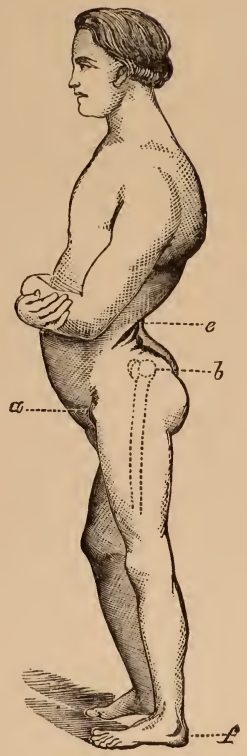

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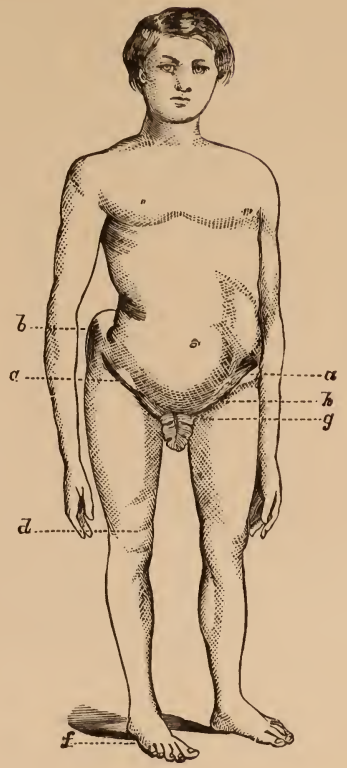

Fig. 3.

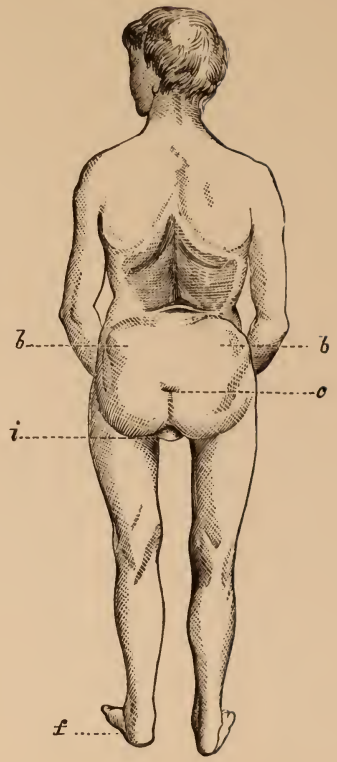

Fig. 1.

Fig. 2.

J. Knight lith.

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TREATMENT OF RIGID DEGREES OF FLAT-FOOT BY THE TALLERMAN-SHEFFIELD LOCALIZED HOT-AIR BATH.

By W. J. WALSHAM, F.R.C.S.,
LONDON, ENGLAND.

For the last fourteen years I have been accustomed to treat the numerous cases of rigid flat-foot that came under my care in the Orthopedic Department of St. Bartholomew's Hospital, either by manipulation and massage, or by wrenching under an anæsthetic. For the last six months or so I have substituted for this treatment the use of the Tallerman-Sheffield hot-air bath. The class of cases most suitable for manipulation and massage are those in which on taking the foot in two hands and making pressure on the head of the astragalus with the ball of the thumb, whilst at the same time adducting and inverting the front of the foot, the muscles gradually yield, and the foot can be made to assume its normal shape, the arch being completely restored for the time being. This manipulation, however, is attended with acute pain, and on relaxing the pressure the foot at once resumes the deformed position. By repeating the manipulation, which on each application becomes less painful, daily, or, better, several times a day, for a week or two, the rigidity can generally be overcome, especially if the patient can take rest during the treatment. The foot is then in a condition for the flattening to be permanently cured or relieved by exercise, combined with some form of valgus boot. For this variety of rigid flat-foot the hot-air bath is most useful. After the rigid foot has been in the bath at a temperature varying from 270° to 280° F., or higher, for half an hour to three-quarters of an hour, it comes out quite supple, and on taking it in the hand the arch can be restored without any pain or the application of any force. After a few hours the rigidity gradually

returns, and the process, like the manipulation, has to be repeated. The bath does not, of course, cure the flat-foot, but merely by getting rid of the rigidity places it in a condition to be acted upon by the exercises or other means employed for its permanent relief. The advantage of the bath-treatment over the manipulative consists in the entire absence of pain attending it. The bath should be employed once or twice daily, the patients resting in the intervals, until the rigidity has disappeared.

There is a more severe degree of rigid flat-foot, however, in which the foot cannot be restored by manipulation, but in which, nevertheless, the foot yields more or less completely to wrenching with the patient under an anæsthetic. No hard and fast line can, of course, be drawn between these two degrees, or, indeed, between the degree in which the foot can be wrenched into shape under an anæsthetic, and the still more severe form of rigid flat-foot in which osseous changes have occurred and in which nothing less than an operation on the tarsus will suffice to restore the arch. This last class of cases is, in my experience, very rare. I have only met with two or three cases in the last fourteen years in which I have found that the foot could not be corrected by wrenching, and in which I have consequently been driven to more severe measures, such as Ogston's operation. In the rigid cases (*third degree* or *advanced flat-foot*) in which manipulation does not suffice, the localized hot-air bath is also useful, but only for the less severe degrees of this variety. For the cases bordering, if such an expression may be used, on osseous deformity, I have found an anæsthetic still needful. After the hot-air bath has been employed in the milder forms of these rigid degrees that will not yield to manipulation, the foot does not come out supple as it does in the cases that yield to manipulation, but on taking it in the hands it can, in many cases, be easily made to take a better position, adhesions being felt to give as when the foot is wrenched under anæsthesia. The wrenching, however, after the bath is not quite devoid of pain, but the pain is usually much less severe than that which is caused by manipulation of the variety that yields to this method. In a few very severe cases not much, if any, good has been obtained from the bath, although it has been repeated on successive orthopedic out-patient days for many weeks.

For those who are not acquainted with the bath, it may be said that it is an ingenious apparatus for keeping the air really dry, so that a temperature from 250° to 300° F. can be borne for an indefinite time. It consists of a copper chamber varying in size and shape according to the part it is desired to treat, but generally taking the form of a cylinder. The foot, knee, or the whole leg, including the hip, may be placed in it, and similarly the hand, forearm, or whole arm. The limb, or part of the limb, to be treated is passed into the open end of the cylinder through an air-tight curtain, which is afterward secured in such a way as to close the chamber completely. The distal end of the cylinder is furnished with an ingenious arrangement which plays an important part in keeping the air dry. The heat is supplied externally by gas-jets or oil. The temperature is indicated by a thermometer, the bulb of which is inside the cylinder at the level of the limb, whilst the scale passes outside where it can be read off. The cylinder is furnished with a double stopcock which can be connected with an air-pump and used either for drawing off heated vapor or admitting medicated vapor. The limb rests at the bottom of the cylinder on a metal cradle protected by asbestos, which prevents all danger of scorching the skin by contact with the heated metal. The patient can lie in bed or be seated in an arm-chair during the treatment. The most convenient way of using the bath is to heat the cylinder up to 150° F. before inserting the limb, and then gradually raise the temperature, the process of drying the air being frequently repeated, which enables the patient to bear exposure to a temperature of 250° to 300° F., or even higher, without discomfort.

This striking result seems due to the system of ventilation employed, since each time it is brought into play a considerable higher temperature can be borne without incommoding the patient until the air again becomes charged with moisture evaporated from the skin. The plan of keeping the air dry is the distinctive feature of the bath.

It may here be mentioned that the physiological effects of the bath are: 1. Profuse perspiration of the part treated. 2. Increased flow of blood through the skin of the part. 3. Softening and relaxation of the tissues. 4. General perspiration over the whole body and a raising of the temperature of the blood one or two degrees.

I have used the bath in many other affections than flat-foot, as stiff and painful joint, sprains, rheumatic affections, etc., but with these the present paper is not intended to deal.[1]

I have now notes of a number of patients with varying degrees of rigid flat-foot who have been treated by the bath. A few illustrative cases will suffice :

CASE I. *Rigid flat-foot reducible on manipulation.*—A. B., aged twenty-two years ; stands all day ; both feet very rigid and painful ; exercise cannot be done ; has been wearing a valgus-boot for months.

February 25, 1895. Bath 260° F. for twenty minutes. Both feet came out quite supple and completely restored.

March 4th. Less pain. Feet again rigid. Bath 260° F. for three-quarters of an hour. Feet quite restored. All rigidity gone.

11th. Still unable to do exercise. Much less pain in feet. Some rigidity. Bath 250° F. for half an hour. Feet perfect. Suppleness returned. Placed in plaster in corrected position.

18th. Feet very pliable in every direction. Have retained their pliability. Can do all valgus exercises perfectly. To continue exercise and wear simple valgus-boot.

CASE II. *Rigid flat-foot reducible on manipulation.*—C. D., aged fourteen years. Both feet flat, painful and rigid ; cannot do exercise.

February 25. Bath 290° F. for half an hour. Left foot well restored, soon becoming rigid again. Right foot only partially restored. Left foot put in plaster in restored position.

March 11th. Bath 260° F. for fifteen minutes. Left foot quite supple and restored. Right foot better ; can be almost restored on wrenching.

18th. Can stand on tip-toe and do exercise very well. Right arch not so good as left. Bath 210° F. for half an hour.

25th. Does exercise very well. Right foot still improving. Bath.

April 8th. Both feet perfect. Arch and suppleness retained. To continue exercise. Baths to cease.

CASE III. *Rigid flat-foot irreducible on manipulation.*—G. H.,

[1] The bath can be obtained of the proprietors, 1 and 2 Chiswell Street, Finsbury Square, London, E. C.

aged thirty-two years; both feet very rigid and painful. Incapacitated for work.

February 18th. Bath 250° F. for one hour. Both feet became supple, and arches restored.

25th. Feet soon became rigid after last bath, but both were found less rigid than before the bath. Bath 250° F. for half an hour. Feet perfectly restored; put in plaster.

March 4th. Feet still slightly rigid. Bath 260° F. for half an hour. Feet quite supple. Exercise begun. Plaster.

11th. Less rigid. Bath 280° F. for half an hour. Feet quite supple. Exercise better done.

25th. Feet much improved. Left foot very good. Bath 250° F. for half an hour.

April 1st. Still progressing. Does exercise fairly well. Rigidity, almost gone. Fitted with valgus-boot. Exercise to be continued.

Case IV. *Rigid flat-foot irreducible on manipulation.*—C. J. B., aged twenty-two years. Right foot very rigid. Left foot scaphoid and astragalus extremely prominent, probably bony changes.

February 18th. Bath 235° F. for half an hour. Right foot completely restored. Left foot unaltered. Cannot be wrenched into position. Both feet placed in plaster-of-Paris.

25th. Feet kept in plaster. Very rigid. No bath.

March 11th. Right foot in good position. Left same as before. Bath 250° F. for half an hour; left foot only. Prominence of scaphoid slightly reduced.

18th. Right foot much improved. Left foot better, but bones still prominent. Bath 240° F. for half an hour. Bones further reduced. Whole foot more supple.

25th. Left foot more pliable, but still rigid. Bath 240° F. for half an hour. Bones incompletely reduced. From this date the foot further improved, but was not completely restored.

Case V. *Rigid flat-foot irreducible on manipulation.*—S. S., aged forty years. Rigid flat-foot of some years' duration. Both feet. Astragalus and scaphoid very prominent. Thickening about Chopart's joint.

May 20th. Bath 270° F. for half an hour. Pain less. Foot could not be reduced. Rigidity slightly less.

27th. Very little improvement. Bath 270° F. for half an hour.

June 3d. No improvement. Bath 270° F. for half an hour. Little or no improvement. Plaster-of-Paris.

10th. Feet still rigid. Wrenched under an anæsthetic. Improvement in position. Plaster-of-Paris.

Feet never completely restored, but the pain and disability much relieved. To wear valgus-boot and leg-irons.

A CASE OF PARALYTIC VARUS FOLLOWING ACCIDENTAL DIVISION OF THE EXTERNAL POPLITEAL NERVE. NEURORRHAPHY SIX YEARS AFTERWARD. NO BENEFIT.

By E. MUIRHEAD LITTLE, F.R.C.S. Eng.,
LONDON, ENGLAND.

Rose W., aged twenty-one years, was admitted to the National Orthopedic Hospital in March, 1894. Patient states that in 1888 she was admitted to an institution in London (lately somewhat notorious), suffering from in-knee. The biceps tendon in the left limb was divided in the ham. Soon after the operation she was told that "they had cut more than they intended." She found that she had lost sensation over a great part of the foot and leg, and that she could not turn out the foot or extend the toes. The foot and leg afterward became cold and the skin red or purple. She says that after about three months sensation in the parts affected was restored, but no improvement took place in muscular power. The foot became more and more turned inward, and the heel drawn up.

State on admission. Patient is a healthy-looking young woman. She walks with a well-marked limp. The left foot is in the position of equino varus of moderate degree. The skin of the foot and leg is cold and congested and rather shiny. Sensation is not less acute than on the corresponding part of the right limb.

There is no reaction to faradization in any of the muscles supplied by the perineal nerve. There is very slight reaction in the long extensor of the toes to the galvanic (continuous) current. The toes are flexed, and can only be extended by manipulation with some difficulty. The foot cannot be brought into a correct position by manipulation.

On March 14, 1894, ether was administered. An incision about six inches long was made at the outer side of the popliteal space over the course of the perineal nerve. After some dissection the proximal end of the nerve was found amidst a good deal of fibrous tissue. It was swollen and bulbous. The distal end was then sought for behind the head of the fibula, and found after some trouble. It was thin and wasted. There was an interval of three inches between the two ends. The nerve-ends were refreshed and united by four carbolized catgut sutures. To bring them together, gentle traction was made, and the limb flexed to nearly a right angle. The scar tissue was removed as far as possible. The wound healed by first intention. No improvement in the condition of the foot and leg followed, but they were daily galvanized (continuous) for some six months without effect, except that the circulation in the skin was improved. The position of the foot was afterward rectified by tenotomy and Scarpa's shoe. She left the hospital in November, wearing a boot with steel support.

This case is an interesting one as showing the disastrous result of careless section of the biceps cruris tendon. In cases where this structure really needs division it stands out when the limb is extended by the assistant so as to be free of the dangerous neighborhood of the nerve, and in my opinion the accident should not happen to a careful operator who makes his puncture high enough up the limb. If, however, the surgeon cannot satisfy himself of the relative position of the parts so as to be sure of avoiding the nerve, it would be better to operate by open wound and lay bare the tendon before dividing it. Should the nerve be divided, suture should of course be performed as soon as the nature of the accident is recognized.

It is much to be regretted that this course was not followed in the case reported. The case was not a hopeful one when it came under my care. The long time that had elapsed since the accident, and the results of electrical tests, made it not likely that innervation could be restored to the affected muscles.

It is interesting to note that sensation was restored, apparently through communicating branches of the internal popliteal, while motion and vasomotor contraction was not improved.

OBSERVATIONS ON CONGENITAL DISLOCATION OF THE HIP.

By BERNARD E. BRODHURST, F.R.C.S.,
LONDON, ENGLAND.

Congenital dislocations of the hip are for the most part traumatic. They occur also, however, through deficient development.

Any obstruction at birth, whether through malformation of the pelvis or caused by the position of the child—the breech, for instance, presenting, or the child or its head being unusually large—may occasion this dislocation.

In a breech presentation the thighs are flexed upon the abdomen, so that the head of the femur presses on the posterior and inferior portion of the capsule of the joint. But, in this position, the application of the slightest force in downward traction will displace the head of the bone and cause it to pass away from the acetabulum and lie upon its brim. And lying on the border of the cotyloid cavity, extension of the limb at birth is alone sufficient to displace the head beyond the brim. The blunt hook or the finger in the bend of the thigh, to facilitate and hasten the birth, may easily thus displace the head of the bone. And, indeed, such is the result of downward traction. A sensation of sudden yielding of the limb is felt, and at the same time a click is heard, and the caput femoris at that moment escapes from its shallow acetabulum. Dr. Tyler Smith informed me that this was his experience in such cases, and that this accident had occurred more than once in his practice.

After my essay[1] on this subject was published I saw two cases of congenital dislocation with Dr. Tyler Smith. One was a boy, aged fifteen months, with dislocation of the left femur, and the

[1] St. George's Hospital Reports, vol. i. 1866.

other was a girl, aged five months, also with dislocation of the left femur. The boy was a well-developed and large child, and the girl had a large head. There was not any other abnormality in either of these children. In both birth was considerably delayed: in the first by a breech presentation, and in the second by the large head. In each case reduction of the dislocation was easily effected, and there was not any subsequent displacement.

It has already been stated that children in whom this dislocation occurs are not infrequently unusually large. This was especially remarked with regard to two boys in St. George's Hospital. I admitted these boys as in-patients, each having congenital dislocation of both hips. One, aged twelve years, was as big as a large boy of fourteen, and the other, aged fourteen, was like a strong boy of sixteen or seventeen. So much was this the case that doubt was expressed on this question of age, and a special inquiry was made, when the facts were verified. And in the case referred to by Mr. Holmes,[1] and recorded at greater length by myself,[2] in which the right femur was dislocated, the child's head was of unusual size. Also in a case where I operated with Dr. De la Cour, and where both hips were dislocated, the head was enormous.

But traumatic congenital dislocation does not alone occur at birth, it may also be occasioned *in utero*. I[3] have recorded several instances where, as the result of accident and shock, spasmodic action was set up, and this was followed by dislocation and fracture and distortion.

Cruveilhier[4] has given a representation of a full-grown fœtus with luxation of the heads of the thigh-bones, and with clubbed hands and feet; and he observed that the heads of the thigh-bones, as well as the cotyloid cavities, were progressing to their normal development. Also, there is found in the hydrocephalic and the anencephalic fœtus every form of luxation and subluxation, together with muscular retraction in every variety.

Thus I have endeavored to show that the agencies producing congenital dislocation are various, and that the conditions of the

[1] The Surgical Treatment of the Diseases of Infancy and Childhood, p. 220.

[2] St. George's Hospital Reports, vol. i. p. 219.

[3] Medico-Chirurgical Transactions, vol. xliii. 1868; Holmes's System of Surgery, vol. iv. art. Intra-uterine Fractures, 1864.

[4] Anatomie Pathologique du Corps Humain, tome i.

femoral head and of the acetabulum vary as the period at which dislocation is produced varies.

In pathological museums, dislocations occurring, whether *in utero* or at birth, whether alone or complicated with fracture or distortion, with malformation or monstrosity, whether development is complete or arrested or irregular, are all treated as though they depended on a common cause; and thus much confusion and misunderstanding have arisen.

Thus, since there are varieties of congenital dislocation of the hip, treatment must also vary. For instance, when the child is well developed and there is no other abnormality existing, reduction of the dislocation may be effected within two years after birth; and this period may be extended to three or four years when exercise has not been permitted. The caput femoris may then not only be easily reduced, but it will probably be retained in the acetabulum. But after this time the acetabulum becomes more or less filled up with fatty or with fatty and fibrous matter, and retraction of the trochanteric muscles takes place; so that, even though the head of the femur may be drawn down, difficulty will probably be experienced in retaining it *in situ.*

It is important to determine the length of time during which the acetabulum may be expected to retain its depth and cartilage and the head of the femur its size. And in illustration of this question I will refer to specimens taken from a boy sixteen years of age by Fournier, and presented by him at the Société Anatomique, of which Professor Cruveilhier was President and on this occasion in the Chair.

"The cotyloid cavity," says Fournier, "retains its form, except that the outer lip is slightly flattened; also it retains its depth and cartilage. The cavity contains a fatty substance, with which it is entirely filled." A new cavity for the head of the femur had been formed, and the head itself was somewhat flattened, but it retained its normal size, and it was covered with cartilage. There was no trace of the round ligament. Inasmuch as there was a history of a fall and subsequent lameness when the child was three years of age, M. Broca raised the question whether this was a congenital or a traumatic dislocation; and M. Legendre observed that congenital dislocation usually passed unobserved until the child began to stand

or walk, and if he then fell it was supposed that dislocation occurred at that time. Whereupon Cruveilhier summed up the discussion, and expressed his opinion that neither the position of the femoral head, nor the condition of the cotyloid cavity, nor the absence of the round ligament, were characters sufficiently decisive to enable him to determine whether this was a congenital dislocation or an old traumatic dislocation—" de décider si la luxation est congénitale ou seulement traumatique et ancienne."[1]

Thus Cruveilhier, than whom no one was better able to judge, acknowledged that in congenital dislocation of the hip, even after sixteen years, the acetabulum may retain its form, depth, and cartilage, and the femoral head its size and cartilage.

I have many times found that the depth of the acetabulum was normal at various ages and up to twelve years; and having first ascertained with a needle probe that such was the case I have proceeded to replace the head of the femur. But if there was difficulty in overcoming the force of the retracted muscles, I have divided these subcutaneously, viz., the trochanteric muscles and the adductor longus. Lying as it does, superficially, it is easy to judge of the size and shape of the caput femoris, and to know with certainty if it can occupy such a cavity as the acetabulum.

Having thus divided the various muscles at their several insertions, the head of the femur may be drawn down and firmly fixed with bandages, and with weights attached to the knee and the ankle. The head of the bone remains fixed, and there is no tendency to displacement, so that after four weeks passive movements may be instituted. In another fortnight, active movements in the recumbent position are allowed to commence; and when the limb can be fairly abducted and flexed voluntarily the patient is fitted with a suitable support, and is then allowed to stand and walk.

The following case will perhaps sufficiently illustrate the manner in which I have treated a large number of similar dislocations during the last thirty years.

In April, 1895, I divided, with Mr. Henry Baker and Mr. Bailey, the trochanteric muscles and the adductor longus in the left femur of a well-developed and healthy girl, twelve years of age, in

[1] Bulletins de la Société Anatomique, 1855, p. 267.

whom there was not any other abnormality present; having previously probed the acetabulum to ascertain its depth. The femoral head was then dislodged and drawn down. Extension was made on the fourth day, when the wounds had healed; and the head of the femur was then firmly fixed in the acetabulum; from which there was no tendency to escape. The hip-joint was firmly bandaged, and extension was kept up day and night. In the course of four weeks passive movements were instituted, and two weeks later active movements were made in the recumbent position. In twelve weeks she was fitted with a hip support, and was allowed to stand and walk. In standing, both limbs were of the same length; and, although there was slight yielding of the limb, there was no displacement in walking. In July the child walked firmly and without limping; and when recumbent she could flex the thigh entirely on the abdomen.

Where the acetabulum is so much filled up that it is impossible for the caput femoris to find a lodgement, I have with a specially curved gouge removed so much of the deposit as I could subcutaneously, to deepen the cavity sufficiently to retain the head of the femur; but I have not done this through an open wound, after the manner of Professor Lorenz, of Vienna, and of Dr. Hoffa, of Wurzburg; nor have I found any difficulty in working the gouge subcutaneously. But where the gouge has to be used, the joint movements are less free, and there is a tendency to ankylosis.

Notwithstanding, this operation is a great gain when the dislocation is single or, after good motion has been established on one side, when dislocation is double. When consolidation has taken place and a new articulation has been formed, as in Fournier's case, I never interfere; but at any period before consolidation is complete the head of the femur may be drawn down after the trochanteric muscles have been divided, and, with or without the gouge, the head of the femur may be safely and permanently restored to the acetabulum.

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